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Volume 10 OCTOBER, 1945 Number 1

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Products finishing

Attitude . . .

As a woman who inherited a metal-finishing plant less than a year ago, I may not have done too badly in keeping it going and making it show a profit. I wouldn't know, for I have no standards by which to judge. Not being technically trained, I had to learn fast or go under. But I do have a discerning eye when it comes to human nature, and of all the human natures in my plant, by far the most interesting is embodied in a little, old shriveled-up black mummy called Uncle Ned.

You've heard the song about Uncle Ned, who had no wool on the top of his head? This might have been the same darky, for he was old when my father hired him years ago. And for the personification of day-in and day-out cheerfulness you could never beat Uncle Ned. I finally made up my mind to talk to him about it.

"What makes you so cheerful all the time, Uncle Ned?" I asked him.

"Well, Missy, why not? Ain't no use makin' long faces."

"But don't you get tired lugging all those heavy parts around all day?"

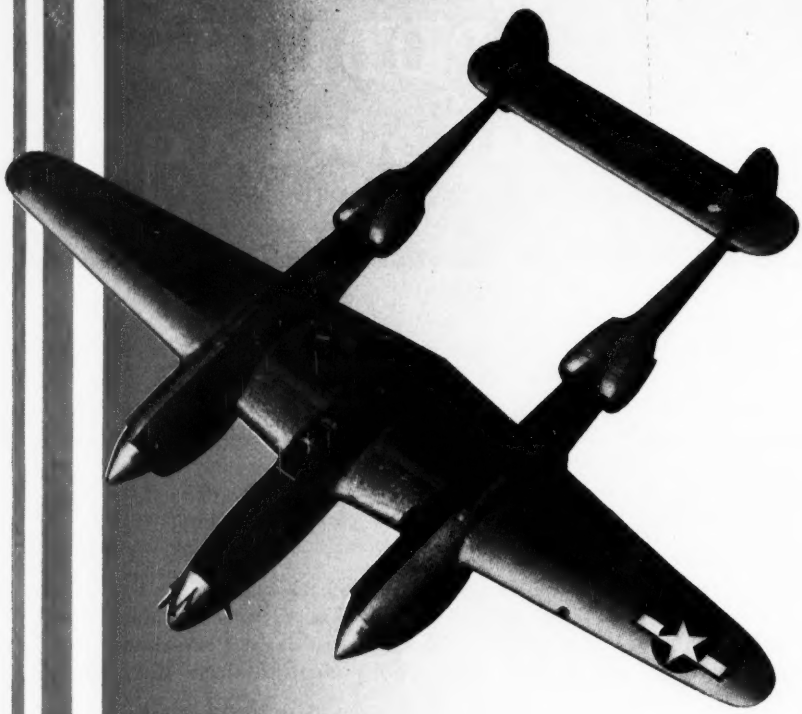
"Course ah does, Missy. But what uv it? Ah rests up again."

"Do you really like all this? Don't you ever get fed up?" I pursued.

He showed teeth that were whiter than mine. "Missy," he beamed, "ah like everythin' 'cept evil."

I swallowed a little at that, then went on, "And so you should, Ned. But isn't there anything at all that worries you? Not even those seventeen blue-star grandchildren?"

It was his turn to swallow, then his eyes regained their twinkle. "It's fifteen now, Missy. Two of those is gold stars. But even that don't worry me none, Missy. You see, us darkies, we got music in our souls."



Latest improved model of the fighting Lightnings is this new super-range fighter which is designed to fly faster, higher, and farther than previous model Lightnings. The illustration shows the location of the four air intake and exit ducts on the twin booms of the P-38. Formed from lightweight sheet steel, they are joined with a thin steel shell formed to fit their inner contours.

Processing Metal Components at Windsor Engineering

By FRED M. BURT

IN the plant of Windsor Engineering Co., Inc., Glendale, California, hundreds of thousands of aircraft component parts, ranging from tiny springs to ammunition trays and air scoops or collectors, are given the Irco-Izing process chemical dip treatment to inhibit rust and are then dipped and/or sprayed. In addition, many other metal parts are similarly processed for other plants in the country.

Figure 1 comprises a view of the production line in the Windsor plant. The tanks are located 3 feet from the side wall, thus allowing ample space for steam lines and a 2½-inch sewer at floor level, as well as other piping. Pipe coils are provided on both sides of all tanks that require heating, and the steam carried to them in insulated pipers is produced by a Thompson tubeless vertical boiler of 30 h.p. capacity.

The first tank in the production line is made of steel and measures 5 feet wide x 6 feet long x 3 feet deep. This tank contains a boiling solution of Oakite No. 24 alkaline cleaner which is used whenever heavy grease or paint must be removed from steel parts received. The second tank is made of wood and is 4 feet in diameter x 4 feet deep. It contains an unheated solution of equal parts of Kelite Scale Off and water which is used to remove any scale found on steel parts, such as resulting from heat-treating operations.

Following a 32-inch working space is a Penetrol solvent tank having two sections, each 4 feet wide x 7 feet long. The first section contains the solvent and is 29 inches deep. It includes an inner basket made of sheet steel with close-spaced 3-inch diameter perforations for drainage. The outer edges of both the steel tank and basket slope inward at very steep angles. The inner top edge of the basket is hinged so that when the outer edge of the basket is lifted by a hoist and an overhead steel arm attached to trunnions on each end of the basket, the hinged side forms an axis. As the basket is raised in slow revolution around this axis, the solvent drains out and off of the parts. When drainage is completed and the basket is raised sufficiently far, the contents slide slowly into the next section of the tank and onto its horizontal false bottom, 8 inches from the top of the tank and similarly per-

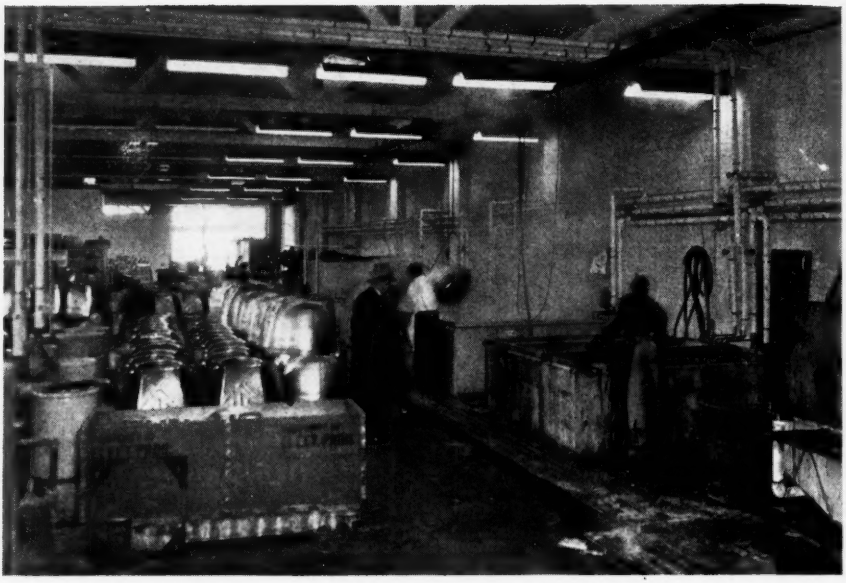


Fig. 1—This illustration shows a view of the Windsor production line, beginning with the Penetrol solvent tank and ending with the paint spray booth. The operator in the center of the illustration has just hoisted treated work from a tank containing a rust-inhibiting solution.

forated to the work basket. A counterbalanced heavy vertical steel plate 7 feet long is then raised to separate the two tank sections so as to keep the water spray out of the solvent.

In the second tank section, the last vestiges of Penetrol are removed from the parts by means of a fine spray of hot water which saponifies the Penetrol on the metal surfaces, thus enabling the resultant soap to be quickly washed away. A flexible hot water line, fed from the boiler, and a compressed air line with 160 to 180 lb. pressure are attached to the mixer of the spray nozzle and are regulated to provide a high pressure spray.

The next three tanks in the production line are each 30 inches wide x 30 inches deep x 7 feet long with approximately 330 gallons capacity, and are positioned in one block. As with other tanks containing hot solutions, these tanks are provided with two inches of wood fiber insulation between the tanks proper and the light sheet steel outer shells. One tank contains boiling Kelite Keprocess alkaline cleaner which is used for the final cleaning of parts. After being immersed for a short time in the cleaner, the baskets of parts are then lifted over into another tank for a hot water rinse. This tank has one steam pipe in the bottom, with agitation afforded to the water from air jets (connected to a compressed air line) also at the bottom of the tank. At one end and near the top of the tank is a horizontal overflow level extending from one side to the other. At the other end of the tank and slightly higher is a transverse water pipe having a row of ten holes from which hot water is constantly sprayed, thus inducing a water flow

7 SOLUTIONS

TO METAL PRODUCTS CLEANING PROBLEMS

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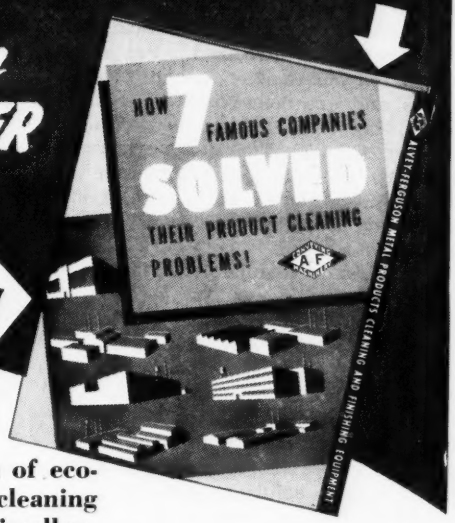

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that keeps impurities skimmed off of the surface.

Another tank in the block of four contains an unheated neutralizing solution of phosphoric acid. When scale is removed from work in the second tank in the production line, the parts are conveyed to this phosphoric acid tank where the acid of the Scale Off solution is neutralized. Parts so treated by-pass the other cleaner tanks and are conveyed to the tank containing Kelite Keprocess alkaline cleaner. All transfering of parts from tank to tank is done with one of three ¼-ton electric hoists which are manually propelled and travel on an overhead I-beam.

After final cleaning, the parts are immersed in one of two Irco-Izing tanks, each of which is 64 inches wide x 7 feet long x 3 feet deep. The strength of the Irco-Izing solution when first made up is that which is obtained from the addition of one gallon of the Irco-Izing compound to 100 gallons of water. This solution and the cleaning solutions are given titration tests as often as is deemed necessary in order that additions may be made to maintain a proper working strength.

The temperature of each Irco-Izing tank is maintained at 180 deg. F. by means of removable steam coils on each side of the tank. Thermometers on the wall ends of the tanks are frequently examined so that the steam may be regulated to maintain the 180-deg. temperature.

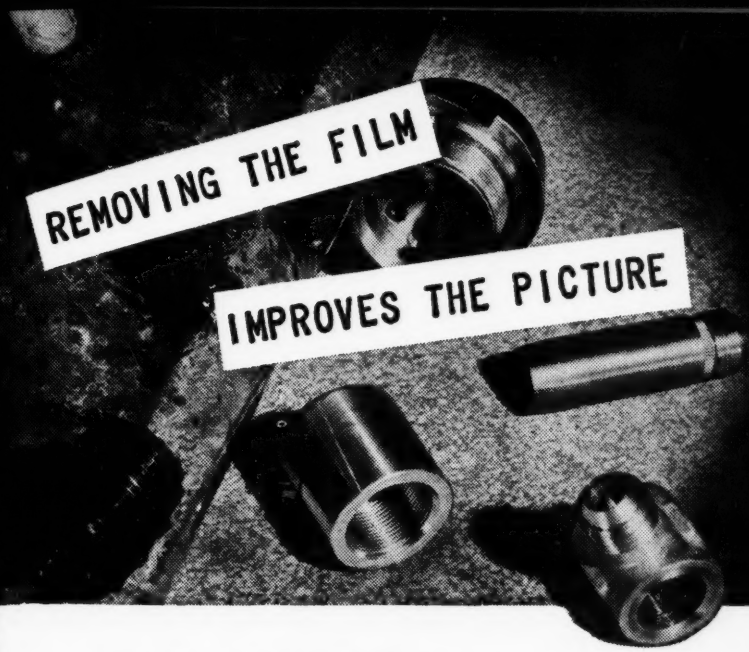
In the bottom of each tank is a 4-inch deep sludge pan with curved corners and ¼-inch clearances which must be removed and washed out at regular intervals. The heavy 1-inch coping at the top of each tray retains the sludge during removal and enables the tray to be readily picked up by means of hooks. In lifting out the trays, one side is raised a foot or two higher than the other, thus allowing the liquid to flow over the side while the coping retains the sludge.

A 30-minute immersion or bath in the Irco-Izing solution is required for all work produced under Army or Navy specifications. Parts Irco-Ized for paint adhesion only are given a 15-minute soak.

The ninth tank in the production line comprises a hot water rinse, and adjoining it is a 2-foot wide chromate acid rinse tank, which is used only in meeting certain special specifications. After leaving these tanks, the part containers are placed on the parallel inverted V-shaped steel slats forming the bottom of a dryer, which is made of sheet steel and is 7 feet long x 4 feet 6 inches wide. The slats extend crossways 33 inches above the floor and project 30 inches on each side.

As the load of parts to be dried is placed on the incoming side projecting strips, the counterbalanced side door of the dryer is raised and the parts are slid easily into it. After the parts have been dried, the dryer is unloaded by opening a similar door on the other side and sliding the work out onto the projections there. The drying heat is produced by two sets of gas burner jets located under steel jets beneath the strips. These sheets serve to distribute the heat. The jets are regulated to maintain a temperature of approximately 180 deg. F. which is frequently checked by a thermometer. Located conveniently close to the dryer are two tables, 4 x 12 feet and 8 x 12 feet, which are used for work inspection purposes.

The parts shown in production in Figs. 1 and 2 are air intake ducts which, when completed, are mounted on the booms of Lockheed P-38 Lightnings. The larger rear portions (air exit ducts) of these workpieces



SUN SPIRITS . . . Cuts Costs 60%,

Eliminates Objectionable Fumes, Improves Working-Conditions

A metal-processor was dipping machined parts in a large tank, using a specially prepared chemical solvent for cleaning, before shipping.

Safety Engineers and operators objected to the fumes from the tank, and inspectors reported that an oily film still covered the parts after treatment.

A Sun Engineer was called in and recommended Sun Spirits, a product approved by the plant's Safety Department. Oily films disappeared, and, after a year of use, cleaning-costs had dropped 60%.

For positive cleaning of oily and greasy films, hundreds of industrial plants rely on Sun Spirits. Sun Spirits meets specifications of fire underwriters for cleaning-purposes, cleans quickly and economically. It leaves no spots. For help on metal-cleaning problems, call the Sun Engineer near you. Or write . . .

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follow through the same processes in the plant during production. After the ducts are dried and inspected, they are dipped in zinc chromate primer and hung up to dry for approximately 30 minutes through the use of S-shaped wire hooks on a 2-inch pipe suspended 6 feet from the floor and 28 inches from the wall and extending 40 feet down to a spray booth. The dipping tank measures 32 inches long x 24 inches wide x 25 inches deep. Behind it, located against the wall, is a sloping splash plate and on either side are 5-foot long sloping steel line drain boards with raised edges. Small items are dipped in wire mesh baskets 12 inches long x 8 inches wide x 8 inches deep.

After the air ducts are dried, they are given another coat of zinc chromate primer on the sides that fit against the booms of the plane. The other sides are then sprayed with aluminized lacquer as illustrated in Fig. 2. The four spray booth turntables shown are each 36 inches in diameter and have extra wire mesh tops.

The spray booth is 16 feet long. Two 24-inch diameter vertical galvanized pipes are connected with a strong fan located on the roof of the spray booth. The suction which this fan creates draws the air laden with spray particles from each booth section, back and down through apertures in the rear. Before being drawn up through the pipes for dissipation in the outer atmosphere, the laden air is directed through ducts, down and over a shallow water pan 3 feet wide and as long as the booth. This pan is located on the floor and is filled with approximately 6 inches of water containing Turco flocculating solution which precipitates the paint collected in the water. The water pan is provided with an adjustable overflow at one end which is attached to the main sewer pipe. At the other end is an automatic water valve which admits fresh water whenever the solution falls below a preset level.

In front of the spray booth, three sets of DeVilbiss air pressure gages and air filters are suspended at a convenient height from a wooden framework. These are connected to the main compressed air line having 180 lb. pressure. The De Vilbiss Type MBD spray guns used are fed from either a Binks Model "Q" pressure tank

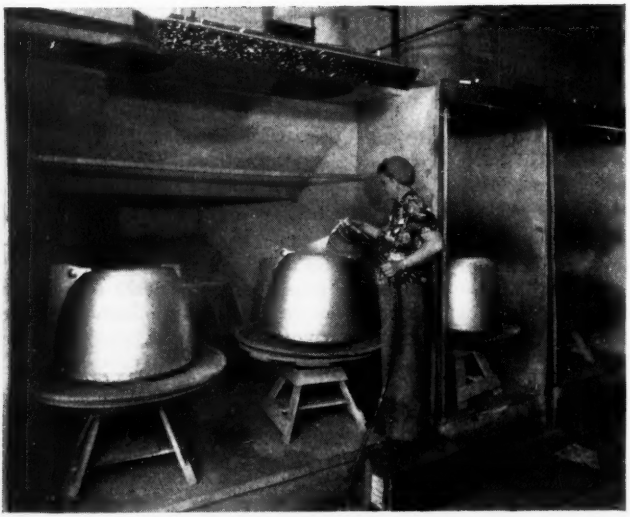

Fig. 2 — Woman operator is shown spraying aluminumized lacquer on P-38 air intake ducts.

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CHARACTERISTICS:

High resistance to soap, grease and floor cleaning detergents . . . perfect matching of color with porcelain-enamel sinks and drainboards . . . complete color stability . . . long wearing qualities (It's both hard and tough) . . . maximum protection against rust.

APPLICATION:

One coat, consisting of two spray passes.

BAKING TIME:

20 minutes at 300° F. (or equivalent).

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All *Vedoc* finishes are developed for a specific use, then slightly varied to best fit each customer's production setup. For more information about these "better finishes", write . . .

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holding 15 gallons of zinc chromate primer or a DeVilbiss tank or pot with a capacity for 6 gallons of aluminumized lacquer. Spraying is done

at 80 lb. pressure with 15 lb. in the tanks to feed the guns.

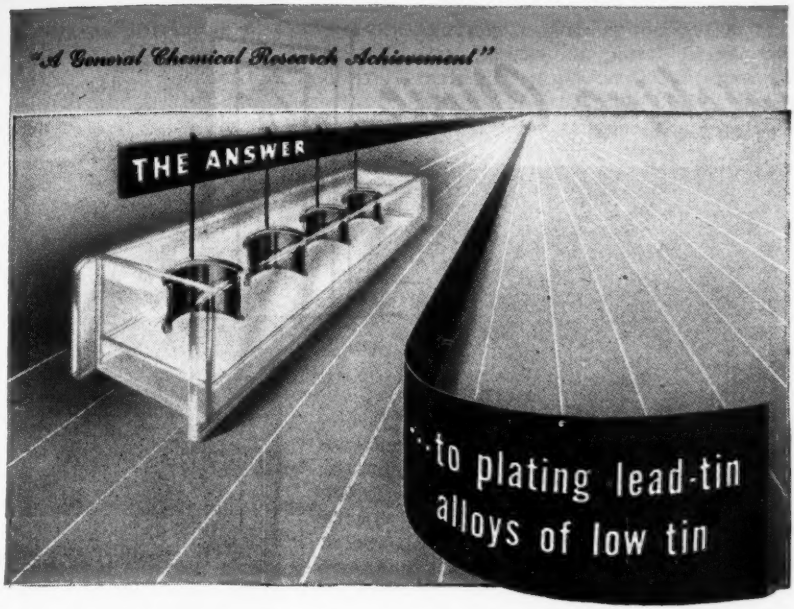
Parts are handled through the various tanks in wire mesh baskets ranging in size up to 78 inches long x 21 inches wide x 10 inches deep and, since the baskets are constantly being rust-proofed, they are not subject to corrision. When the heating coils of the tanks become too encrusted with deposits to maintain good heating efficiency, they are removed and taken to a 7 x 2 x 4-foot deep wooden tank containing a Scale Off solution that lossens the scale, after which the coils are hosed clean.

Pennsalt Industrial Chemicals and Specialties are the subject of a pocket-size booklet now being distributed by the Pennsylvania Salt Manufacturing Co., 1000 Widener Bldg., Philadelphia 7, Pa. The booklet lists the industrial chemicals and specialties manufactured by Pennsalt under the sales division controlling them. In addition, data are included on the industries served by Pennsalt and the addresses of its district sales offices and plants. Copy of booklet free upon request.

Poreclain Enamel Booklet. A colorful booklet describing many of the characteristics and applications for porcelain enamel has been issued by the Porcelain Enamel Institute, Inc., 1010 Vermont Ave., N. W., Washington 5, D. C. Of interest to engineers, designers, and manufacturing and sales executives, the booklet includes a pictorial description of how porcelain enamel is made and applied to metal products, and describes in detail many products in industry that are said to attain longer life through the use of porcelain enamel. Advice as to proper design and procedure in obtaining best results from porcelain enamel is also contained in the booklet, copy of which is available free upon request.

"Grinding and Finishing with Idler Backstands" is the title of an eight-page 8½x11-inch booklet released by the Behr-Manning Corp., Troy, N. Y., presenting complete engineering and production data on the latest methods for speeding up grinding and finishing operations by conversion from abrasive set-up wheels to coated abrasive belts. Thoroughly illustrated with typical production photographs, artists' drawings

and phantom views, the booklet indicates the sound engineering simplicity of the conversion principle and presents in readily understood form the specification range for the various types of backstands, contact wheels, and coated abrasive belts. Copy free upon request.



For more than 25 years metal finishers have sought a successful means of plating lead-tin alloys in the low tin ranges. "Not feasible . . . inoperable . . . too many variables," read published reports on method after method.

Now—with the new chemical tools of General Chemical Fluorine Research—platers are achieving the "impossible."

Here's how: General Chemical *Lead* and *Tin Fluoborate solutions* are thoroughly compatible. Combined in baths using dual or alloy anodes, they plate dense, fine-grained lead-tin alloy deposits uniformly, simultaneously, and *with the tin easily controlled at low ranges!*

Thus, *in one operation* an alloy coating is produced that is harder, more wear-resistant, and has a more attractive appearance than lead plate alone. Little wonder that leaders in the bearing industry are adopting the combination fluoborate bath for lead-tin alloy plating of their products!

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Finishing Clinic

Evaluation of Surface Finishes

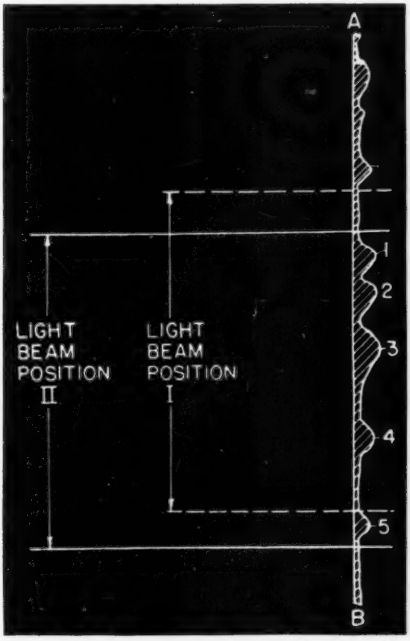
DURING the past decade great advances have been made in the technique of mechanically finishing surfaces, particularly of metal objects. In a large measure this can be attributed to studies in which previously unknown correlations of mechanical and physical properties of metal with the character of their surface were revealed. Because of the widespread interest and importance of the subject, the National Bureau of Standards has investigated the application of nearly transparent surface replicas for evaluation of metal surface finish. This study has resulted in the development of a method for evaluating the finish of a surface through the medium of a properly prepared replica of the surface and is described by Harry K. Herschman in the article "Evaluation of Finish of a Metal Surface" which appeared in the "Journal of Research" of the National Bureau of Standards (RP1625) for January, 1945. The method is timely and offers considerable promise in connection with specifications and standards for surface finish of metals and should be of interest to engineers and designers dealing with such problems.

In the Herschman method, the replica is prepared by applying a suitable solvent to the metal surface, after which a clear plastic film is pressed on. The solvent

softens the side of the film adjacent to the metal surface being examined and permits it to flow and conform under pressure to the minute surface irregularities. Examinations of replicas so produced showed that the degree of transparency decreased with increased roughness of the original surface, and the rougher the metal surface, the more pronounced the variations in the geometry of the reproduced patterns became. This led to the development of an appartus for evaluating surface roughness based on the degree of variation of the geometric characteristics in a nearly transparent replica. This method consisted essentially in passing a narrow beam of light transversely through the moving replica onto a photoelectric cell.

Variations in the geometric character of the film, which are associated with roughness of the reproduced metal surface, control the intensity of the light passing through the film and thereby reaching the photoelectric cell at any particular instant. Fluctuations of intensity of the transmitted light cause a pulsating voltage in the cell circuit which is recorded by an electronic voltmeter. Voltage thus increases with increased surface roughness.

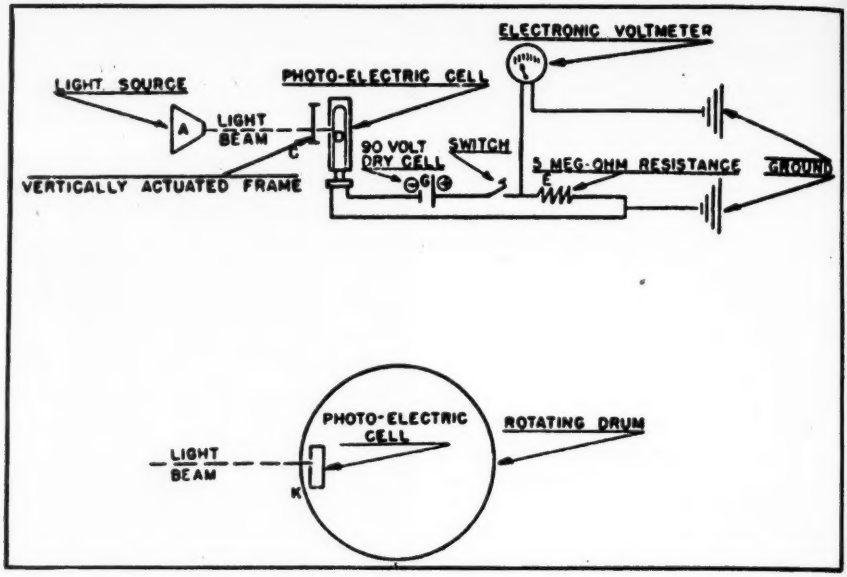
Some of the salient features of the replica method are: (1) easy maintenance of a permanent record of a metal surface finish; (2) rapid average evaluation of a considerable length and width of the surface at one sitting; (3) simplicity of operation; (4) absence of the personal factor; (5) preservation of the surface, even for soft materials such as lead or tin-base bearing metals; and (6) availability of the method, since the replica may be prepared in one locality and transported to the location of the analyzer. In addition, the method is especially sensitive to small changes in surface roughness for the finer grades of metal finish, which makes it of particular interest. Designers and finishing engineers concerned with surface finish will certainly want to investigate this new quantitative tool.



Changes which occur in intensity of light transmitted through a moving replica (National Bureau of Standards)

Brass Plating—Still Most Widely Used Method for Rubber Adhesion

Brass plating is still the most widely used commercial method of obtaining rubber-metal adhesion. Adhesion is dependent on depolymerization of the rubber stock together with the formation of a copper-sulphur linkage. Brass plating for adhesion



Electric circuit of the "replica" surface analyzer developed at the National Bureau of Standards

is adaptable to production use on low carbon steels, some alloy steel, cast and malleable iron, brass, bronze, and manganese steel. High chrome and high silicon as well as some aluminum alloys which are not generally processed by this method are adhered to rubber by adhesion cements. Compounds of natural rubber, neoprene, buna-N and butyl can be adhered to brass plate if they are especially compounded for the purpose. The above information was presented to the Newark, New Jersey section of the Electroplaters' Society by W. Hayford and H. S. Rogers, a discussion of which appears in the May edition of "The Monthly Review," the official publication of the Society.

The process of producing rubber to metal bonded items by brass plating in full scale production includes the following steps:

(1) Clean and brass plate the metal. The brass plating may be done in still or barrel tanks and is adaptable to either semi or fully automatic operations.

(2) Mold rubber to metal under heat and pressure to vulcanize the rubber in required shape and obtain adhesion.

A list of the general type of products in which rubber-metal adhesion is required includes vibration mountings, valves, bumpers, flexible couplings, gaskets, wheels, pulleys, hose, pump impellers, pipe and tank linings, plating racks, and insulators. It is evident above that there are two general classes using either the elastic or protective properties of rubber.

The brass plating process is usually performed by the rubber manufacturer who is processing the article. This is done because of the special type of brass plate required, the simplication of scheduling, and

ACID CLEANING AND DESCALING COMPOUND . . .

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2. As an acid cleaner for removing water scales from feed lines, boilers and a variety of industrial equipment.

4 MAJOR ADVANTAGES:

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2. REDUCES ACID CONSUMPTION: Compared to an uninhibited acid, Pennsalt PM-90 reduces acid consumption since the acid cleaner is consumed principally in the removal of rust and scale and not in attacking the base metal.

3. IMPROVED WORKING CONDITIONS: Acid fuming is controlled, thus contributing to better working conditions in the plant.

4. CONVENIENCE: Furnished in liquid form . . . can be used either directly from the original container or diluted as much as one part Pennsalt PM-90 to four parts of water. The dilution range will be governed by the speed of cleaning necessary as well as requirements of the particular operation.

PENNSALT PM-90 is packaged in returnable 13 gallon glass carboys containing 115 lb. net. For large consumption, Pennsalt PM-90 is also supplied in tank cars of 4,000 gallons each.

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the benefits of centralized responsibility. However, there is no reason why the job plater cannot supply the production department with a suitable brass plate for rubber adhesion purposes. In such a case, it is desirable to deposit a slightly heavier brass plate which is reactivated by the production department prior to use by dipping in 2 per cent cyanide.

All commercial brass baths are cyanide solutions, and most of them are sodium cyanide solutions. A brass plating bath suitable for consistently satisfactory rubber adhesion work according to Hayford and Rogers might have the following composition:

	oz./gal.
Copper (metal)	3.0
Zinc (metal)	0.30
Free NaCN	1.5
Ammonia (NH_3)	0.30
Sodium Bicarbonate (as carbonate)	5-10

Operating Conditions

pH of Bath	9.5
Current Density	7-15 amp./sq.ft.
Temperature	75-90° F.

Dr. H. P. Coats has given the following formula for commercial use in rubber bonding work ("Modern Electroplating"):

Copper Cyanide (CuCN)	oz./gal. 3.5
Zinc Cyanide	1.5
Total NaCN	6.0

Operating Conditions

pH of Bath	10.3-11.0
Current Density	10 amp./sq.ft.
Temperature	80-95° F.

Electropolishing—Present Status

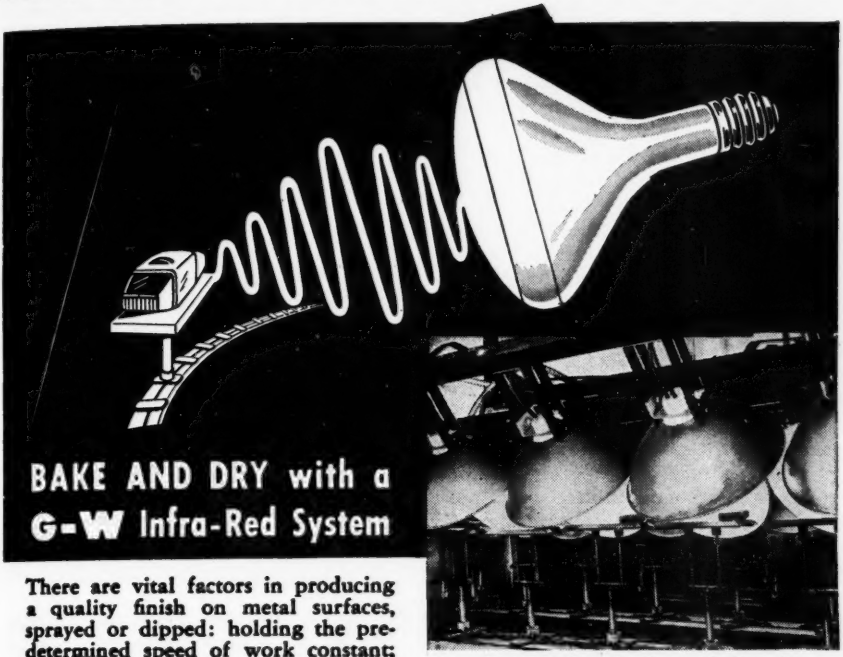
Electropolishing is an established commercial process and is solving a variety of production problems. There is no real reason from the technical standpoint why every common metal used in industry may not lend itself to electropolishing. The ultimate place for electropolishing in industrial finishing operations will probably depend, as would be expected, upon the costs relative to mechanical methods as considered in each particular application. Success depends upon intelligent use in the right places; many plants may realize substantial benefits and savings in finishing by electropolishing.

John S. Crout of Battelle Memorial Institute, which institution has done considerable work in the development of commercial electropolisihing processes, writing in "Metal Progress" for February, 1945, states that each application of electropolishing requires individual study and each installation must be custom built. Furthermore, conditions which make the process technically and economically desirable in one plant make it unacceptable in others.

There are in industry certain applications where grit finishing cannot compete with electropolishing; conversely, there are other operations where electropolishing cannot compete with mechanical methods. In between these limits are found applications where electropolishing and mechanical polishing overlap, supplementing or complementing each other. Interesting future possibilities are opening up, particularly for stainless steel, nickel, copper, brass, Monel, and aluminum as well as plated metals which can also be electropolished.

The most obvious application for electropolishing and the one most frequently thought of today is finishing for appearance where unusual brilliance and color tone can be achieved. Electropolishing offers a new method for imparting a "finished" or "quality" appearance to classes of postwar products previously left unfinished because of the shape

PLAN TODAY... TO CUT FINISHING COSTS... THE G-W WAY



BAKE AND DRY with a G-W Infra-Red System

There are vital factors in producing a quality finish on metal surfaces, sprayed or dipped: holding the predetermined speed of work constant; having baking tunnel of correct length, and lamps in proper number; determining the exact time of baking and drying consistent with the lacquer or enamel used. The "G-W Way" is an infra-red system designed to coordinate *all* these operations to the highest possible degree.

Through cooperation with leading lamp manufacturers almost since the adoption of the infra-red process, G-W is in a position to recommend the right choice of heating units. G-W engineers also have worked closely with manufacturers of organic finishes, and this experience will help you in selecting suitable coatings for your products.

Coupled with this knowledge, is G-W's 130 years of experience in designing and manufacturing standard and custom-built conveyors to meet nearly every kind of industrial material-handling problem.

Take advantage of this unique combination of infra-red and conveying experience, which has produced many systems giving maximum attainable economy with minimum investment, and lowest operating and maintenance costs. Ask G-W for some case histories . . . Gifford-Wood Co., 420 Lexington Avenue, New York 17, N. Y.; 565 W. Washington Street, Chicago 6, Ill. Factory—Hudson, N. Y.

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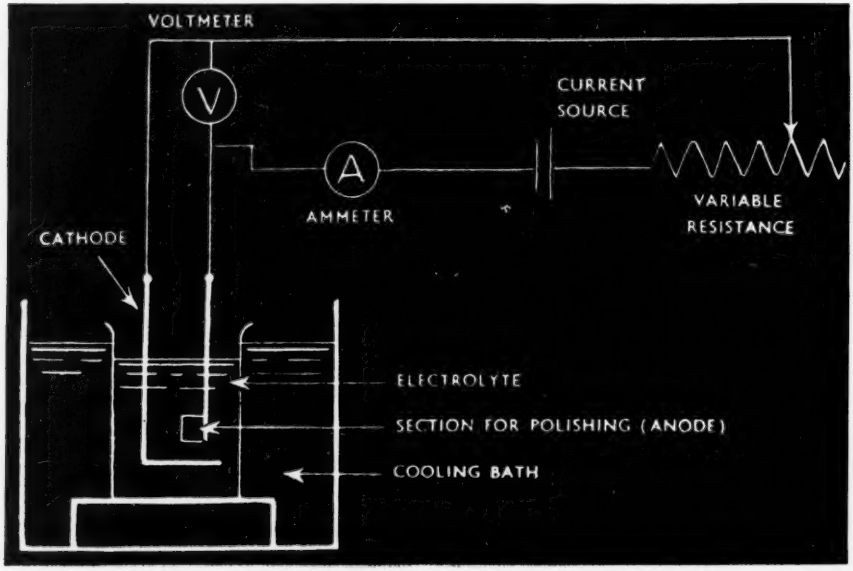
factor or extreme macro roughness. In addition to its utility in "finishing for appearance," electropolishing offers interesting and practical applications in machining metal, where appearance is not of primary concern but where uniform metal removal is. There is one example of an installation in which several thousand parts are electropolished by two operators in a single shift to simply and uniformly remove 0.005 inch of metal. The same production formerly required three men, three shifts on machines. There are many instances where sawing, grinding, stamping burrs, and so on, are more economically removed by electropolishing.

There are several different electropolishing processes, including such solutions as mixtures of perchloric and acetic acids; combinations of sulfuric and citric acid based on a process and patents held by the Rustless Iron and Steel Corporation ("The Iron Age," July 12, 1945); phosphoric acid with glycerine as proposed by Uhlig ("Proc. Electroplaters' Soc.," 1941); and phosphoric and sulfuric acid mixtures developed by Pray and Foust and associates and covered by patents owned by the Battelle Development Corporation ("Proc. Electroplaters' Soc.," 1941). Electropolishing is usually thought of as the reverse of electroplating. From the production standpoint the operating conditions used in electropolishing are comparable to those used in chromium plating.

A considerable amount of interest has been evidenced in the possibilities of electropolishing stainless steels, due perhaps in part to the increasing popularity of this material in the manufacture of many types of articles. While stainless steel provides varying degrees of corrosion resistance, depending to an extent on its constituents, the possibilities that



Typical circuit for electrolytic polishing

Acid-proof TILE LININGS FOR CHROMIUM PLATING TANKS

Chrome plating authorities generally agree that acid-proof tile or brick-lined steel shells make not only the best but the least expensive chrome plating tanks.

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exist for its decoration are strictly limited. For many articles electropolishing appears to offer a means of expanding the usefulness and lowering the cost of fabricating stainless steels.

In developing new uses for electropolishing, Crout ("Metal Progress," February, 1945) reports that at Battelle Memorial Institute the following list of products from a number of different companies have been studied: automobile bumpers, hub caps, radiator caps, horn buttons, windshield wipers, insignia, gears, hardware and dash panels; watch springs, pivots, cases, and gears; refrigerator hardware, trays, and shelves; surgical and dental instruments; aircraft and automobile engine spark plugs, piston rings, and valves; cutlery, tableware, vacuum bottles, electric irons, waffle irons, toasters, and various kitchen utensils; saws, files, drills, reamers, bits, wrenches, pliers, cutters, and similar tools; a variety of aircraft parts; metal milk containers; tubing; wire; needles; household and cabinet hardware; costume jewelry, watch bracelets, belt buckles, and luggage hardware; telephone parts; dies; pipe fittings; molds; bathroom hardware and plumbing fixtures; instrument and meter parts; screws, printing and engraving plates; musical instruments; chemical apparatus and machinery; metal office and home furniture.

With the return to the manufacture of peacetime goods, designers, engineers, and metal finishers should explore the possibilities of electropolishing in their finishing problems. It may be found that an entirely new tool is available for achieving new effects and new economics in manufacturing operations.

Aluminum Coated Steel—New Possibilities

Successful development of aluminum coated sheet and strip steel presents designers with another important engineering material for postwar applications. Aluminum coatings appear to be particularly suited to uses where combinations of corrosion and heat resistance must be met. In addition, the material combines the surface characteristics of aluminum with the desirable physical properties obtained from steel. Engineers of American Rolling Mill Company have found that both low carbon steel and high-strength steels make satisfactory base metals for this coating, thus providing a wide range of physical properties. Other outstanding characteristics of this new material are high heat reflectivity and attractive appearance. The aluminum coatings can be satisfactorily bonderized, making the product suitable for paints and synthetic finishes ("Metals and Alloys," Volume 21, Number 1, p. 88, 1945).

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Produce that extra value in a beautiful finish — are known for economical cutting, cut and color and mirror finishing on all kinds of steel including stainless and carbon steels and hard-to-buff alloys.
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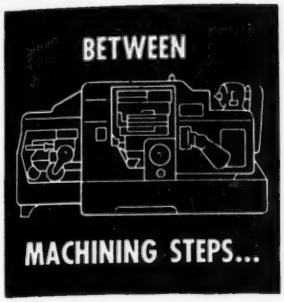

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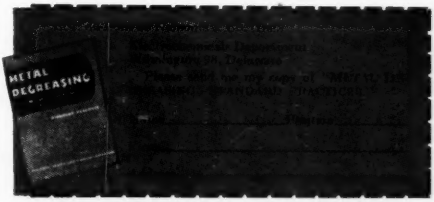
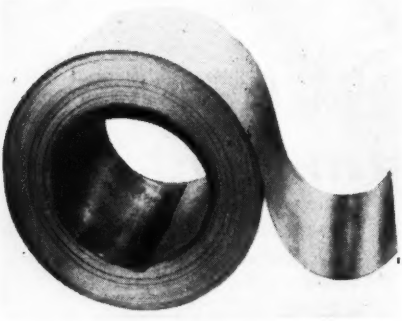


CLIP THE COUPON

Among important postwar applications for volume production are automobile mufflers and exhaust pipes and domestic range ovens. Other uses include containers of all kinds, reflectors for lighting fixtures and similar applications. During the war aluminum coated steel replaced stainless steel for certain aircraft parts requiring heat resistance ("Product Engineering," November, 1944).



Coil of Armco aluminized steel

Corrosion tests on commercial aluminum coated steel in 20 per cent salt spray at 95 deg. F. have shown a coating life of more than 500 hours. When the coated surface is buffed the product has a heat reflectivity of 75-85 per cent in the temperature range 600-1000 deg. Fahrenheit.

Strip for Lead Coatings

For a long time there has been a need for a satisfactory strip for lead coatings on steel. In connection with a study on lead coated steels carried out by Battelle Memorial Institute for the Office of Production Research and Development of the War Production Board, several methods of removing lead and lead alloy coatings were invesigated ("The Iron Age," May 24, 1945). These included (1) a cold and hot chemical strip consisting of a 20 to 30 per cent solution of caustic soda saturated with potassium chromate. (2) an aqueous solution of sulfuric acid and H_2O_2 used as a dip, and (3) anodic electrolytic strip in a solution of sodium hydroxide, sodium metasilicate, and Rochelle salts. The latter solution was found to be the most satisfactory for both the hot dip alloys and electroplated coatings. The exact composition is given below:

	g./L.
Sodium Hydroxide	100
Sodium Metasilicate	75
Rochelle Salts	50

Temperature, 180° F.
Anodic Current Density, 20 amp./sq. ft.

This solution did not attack the steel and left the stripped specimen clean. The other methods investigated either failed to remove alloy coatings, such as lead-tin and lead-tin-antimony, or attacked the base metal.

Analysis of Hydrofluoric-Nitric Acid Pickling Bath

The hydrofluoric-nitric acid pickling bath is widely used in general pickling of stainless steel and is especially valuable in cleaning the siliceous welding flux residue and scale from stainless steel parts after welding or annealing. The solution as made up contains approximately 1 per cent anhydrous hydrofluoric acid and 12 per cent anhydrous nitric acid by weight. Undoubtedly many pickle baths of this type have been dropped with considerable unspent acid or have been operated inefficiently because of lack of satisfactory methods for chemical analysis.

Rapid quantitative procedures suitable for general plant use in analytical control of this type pickling bath have been described for the first time in the Analytical Edition, "Industrial and Engineering Chemistry," published by the American Chemical Society. The article entitled "Analysis of Hydrofluoric-Nitric Acid Stain-

DOWN FOR THE COUNT

• When Wyandotte Metal Cleaners step into the ring, the odds are all against that plug-ugly "Fabricating Compound." For each of these products is a specialist at handling the toughest metal cleaning and degreasing jobs.

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less Steel Pickling Bath" is the result of work carried out at the Engineering Research Laboratory of the Lockheed Aircraft Corporation, Burbank, California, by W. E. McKee and W. F. Hamilton.

The complete procedure recommended for proper control of the pickle bath included the determination of total acidity, iron, fluoride, and nitrate. Although the methods were designed for speed and practical convenience in production control rather than extreme accuracy, the accuracy obtained is more than sufficient for the ranges of concentration allowable. Specific details of the method can be obtained by referring to the above American Chemical Society publication. It is believed that the use of analytical control for the stainless steel pickle bath will result in more efficient operation and improved production in the pickel department.

"Enthone Ebonol Coloring and Blackening Processes for Metals," an eight-page illustrated booklet in color describing coloring processes for copper and copper alloys and blackening processes for zinc and steel, is now available free from The Enthone Co., Dept. PF, 440 Elm St., New Haven 2, Connecticut.

Daniels Plating Barrels. The Daniels Plating Barrel Co., 129 Oliver St., Newark 5, N. J., now has available a 16-page catalog covering various models of plating barrels in single and multiple cylinder units. Designed for use in all types of industrial and electroplating plants, the barrels are fully illustrated and described as to construction features and include types for heavy production plating, light production work and small parts, and for jewelry and novelty plating.

The center spread of the catalog tabulates standard specifications of all types of Daniels Plating Barrels, and the catalog also includes an isometric drawing illustrating parts of one particular type of plating barrel, as well as a parts list. Copy of Catalog No. 45 free to executives upon request.

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How Jensen Ingenuity Helped Koppers Company Lick Tough Job
TWICE as thick at bottom as at top is the metal of these 110 lb. rocket bomb casings. The paint baking problem at Koppers was to achieve *same temperature top and bottom* at time cases leave baking oven . . . so paint color would not vary. To solve this problem, Jensen designed and engineered a special infra-red oven with a unique lamp arrangement. **Result:** *uniform* color over all. *Write Jensen about YOUR problem today!*

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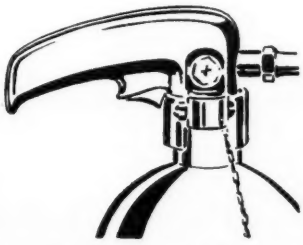
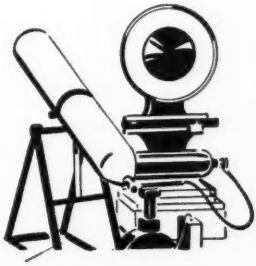


5. Lock open—if desired. Just move trigger forward slightly to latch it in open position—no danger of fouling.



6. Recharge without replacement parts. Merely connect carbon dioxide supply and fill extinguisher up.

Simple, safe and foolproof, this new trigger-control valve on 10, 15 and 20-lb. Kidde extinguishers speeds the attack on fires. A novice can operate it! Write for full details.

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Electricity for the Plater

D. A. COTTON

Part III

BEFORE proceeding to a consideration of concrete applications of Ohm's law, it is necessary to discuss some of the other factors in electric circuits, such as series and multiple or parallel connections.

In Fig. 13, the eight lamps are connected in series across the line and the total line voltage is divided equally between the lamps, each lamp receiving one-eighth of the voltage, assuming all the lamps to have equal resistance. The current passing through each lamp is the same, the amount being determined by the total resistance of the eight lamps. Assume the resistance of each lamp to be 400 ohms, then the total for eight will be 3200 and the current flowing in the circuit will be $I = \frac{120}{3200}$ = 0.0375 ampere. The voltage drop per lamp will be $E = IR$ or $0.0375 \times 400 = 15$ volts or in this case it is simply $\frac{120}{8} = 15$ volts.

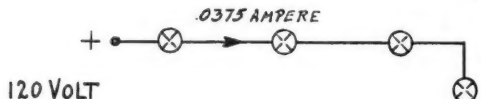

Fig. 13—Electric series circuit

In Fig. 14, we have eight lamps in parallel or multiple. In this case, each lamp has the full line voltage of 120 volts across it and a current of $\frac{120}{400} = 0.30$ ampere will flow through each. This gives a total current in the circuit of 8×0.30 ampere = 2.4 amperes.

Since $R = \frac{E}{I}$ the total resistance of the eight lamps in parallel is $\frac{120}{2.4}$ or 50 ohms.

This is one-eighth of the resistance of one lamp. Thus, we

see that the total resistance, **R**, of **n** equal resistances, **r**, in parallel is $\frac{1}{n}$ times that of one or $R = \frac{r}{n}$, whereas the total resistance of **n** equal resistances in series is **n** times that of one or $R = nr$. Where it is necessary to determine the total resistance of several unequal resistances in parallel, the calculation is not quite so simple as in the case of equal resistances.

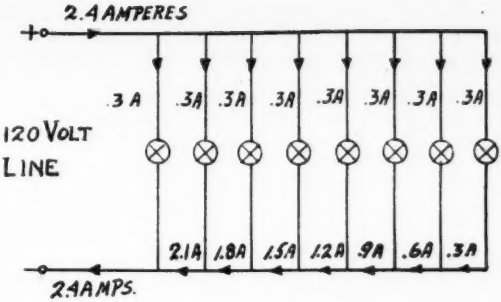

Fig. 14—Electric parallel or multiple circuit

Referring to Fig. 15, we have the following:

Let $\mathbf{E}$ = the voltage of the line.

Let $\mathbf{I_t}$ = total current flowing in the circuit.

Let $\mathbf{I_1}$ = current flowing through resistance $\mathbf{R_1}$.

Let $\mathbf{I_2}$ = current flowing through resistance $\mathbf{R_2}$.

Let $\mathbf{R_t}$ = total resistance of circuit consisting of $\mathbf{R_1}$ and $\mathbf{R_2}$ in parallel.

Then

$$I_t = I_1 + I_2$$

$$I_1 = \frac{E}{R_1} \text{ and } I_2 = \frac{E}{R_2}$$

$$\text{Or } I_t = \frac{E}{R_1} + \frac{E}{R_2}$$

Since the total resistance of the circuit equals the voltage divided by the total current in the circuit,

$$R_t = \frac{E}{I_t}.$$

Then,

$$R_t = \frac{E}{I_1 + I_2} = \frac{E}{\frac{E}{R_1} + \frac{E}{R_2}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} \quad (1)$$

This may be stated: The resistance of several resistances in parallel is equal to the reciprocal of the sum of the reciprocals of the separate resistances.

When two parallel resistances are equal, that is, $R_1 = R_2$, then $R_t = \frac{1}{\frac{1}{R} + \frac{1}{R}} = \frac{1}{\frac{2}{R}} = \frac{R}{2}$ or as previously noted $\mathbf{R_t}$ for **n** equal resistances, **R**, in parallel is $\frac{1}{\frac{n}{R}} = \frac{R}{n}$

Another method for calculating the resistance of two resistances in parallel is somewhat simpler than the reciprocal rule. It is derived from equation (1) above.

$$Rt = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{R_1 + R_2}{R_1 R_2}} = \frac{R_1 R_2}{R_1 + R_2} \quad (2)$$

Equation (2) states: The resistance of two parallel resistances equals their product divided by their sum.

For three resistances, we would have $\frac{R_1 R_2 R_3}{R_1 R_2 + R_1 R_3 + R_2 R_3}$ from which it is easily seen that this form be-

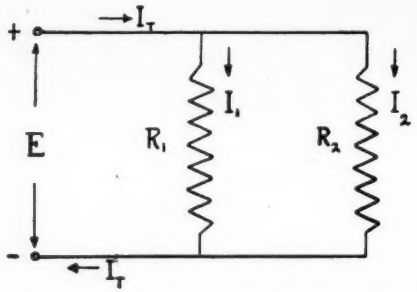

Fig. 15—Development of formula for parallel resistances

comes clumsy when more than two resistances are to be figured. The reciprocal equation is simpler to apply, when more than two resistances are concerned.

In Fig. 16, let us apply Ohm's law to the solution of the constants of this circuit. The line voltage is 120 and resistance $\mathbf{R}_1$ is in series with the parallel arrangement of resistances $\mathbf{R}_2$ and $\mathbf{R}_3$. $\mathbf{R}_2$ and $\mathbf{R}_3$ in parallel have a resistance of $\frac{1}{\frac{1}{3}+\frac{1}{2}} = \frac{1}{\frac{5}{6}}$ = 1.2 ohms (using equation (1) above).

Using formula (2) above, it would be $\frac{3 \times 2}{3 + 2}$ = 1.2 ohms.

Then, the total resistance of the circuit is 4.8 + 1.2 = 6 ohms and the current flowing is $\frac{120}{6}$ = 20 amperes. The voltage drop through $\mathbf{R}_1$ is 20 × 4.8 or 96 volts. This means that the potential at point **A** is 120 minus 96 or 24 volts. The current through $\mathbf{R}_2$ is $\frac{24}{3}$ or 8 amperes and through $\mathbf{R}_3$, $\frac{24}{2}$ or 12 amperes. In this calculation, it is assumed that the resistance of the line conductors is negligible.

Returning to the hydraulic analogy, let us consider the water supply system as shown in Fig. 17, with storage tank and pump to keep the tank filled to a constant level.

If standpipes be erected at regular intervals along the outflow pipe line, it will be found that as the distance from the tank to the end of the line increases, the head of water in the standpipes will be less and less until at the outlet no head of water exists. Certain physical characteristics of the pipe line, such as length, area of cross section, and condition of the inside surface of the pipe, contribute to produce a restriction or resistance to the flow of water through the pipe.

This may be expressed mathematically as $r = \frac{kl}{a}$, where **r** is the resistance to flow of the water, **l** is

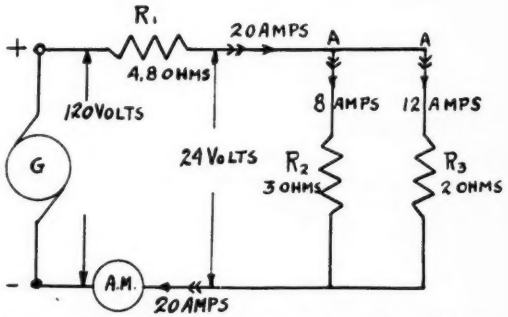

Fig. 16—Problem involving series and parallel resistances

"Fewer Plating Troubles . . .
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Industrial indicating and recording instrument parts in this plant were formerly cleaned of grease, machine oil and buffing compound between processes, before assembly and prior to plating, by manual methods. Now Magnus 220-X is used in the

Magnus Aja-Dip Cleaning Machine
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Not only has there been a large saving in labor, due to greatly increased cleaning speed and volume of parts handled, but more freedom from water breaks has been obtained, with much less trouble due to poor cleaning in the plating processes.

The Magnus Aja-Dip Cleaning Machine, with the right Magnus Cleaner, can boost speed and improve results for you, by the vigorous "shearing" cleaning action it imparts to the cleaning solution by moving the work up and down many times a minute IN the solution.

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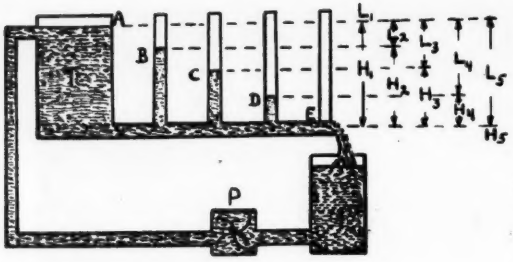

Fig. 17—Hydraulic loss of head

length of pipe, **n** is area of cross-section, and **k** is a constant expressing rough condition of the inside of the pipe. This means that resistance varies directly with the length of pipe and with the roughness of the pipe and inversely with the area of cross-section. It is plain that this formula is practically identical with that given formerly for expressing the resistance of electrical conductors.

As a result of this resistance to flow, there is a continual "loss of head" along the length of the pipe line. In Fig. 17, the letters H_1, H_2 ... H_5 represent "head" and the letters L_1, L_2 ... L_5, "loss of head" along the pipe line at the points **A, B, C, D,** and **E** respectively.

In an electric circuit as shown in Fig. 18, we have a direct analogy with the conditions shown in Fig. 17. Assume that a potential be applied to a uniform resistance **AE** and that the difference of potential be measured from various points **A, B, C, D,** to **E.** Also assume for the sake of simplicity that the line voltage is 120 volts and that the wire is 120 feet long with a resistance of one ohm per foot or a total of 120 ohms. One ampere will be the current flowing and there will be a voltage drop of one volt per foot of wire.

At point **B,** for example, there has been a line drop in voltage (IR) from **A** to **B** equal to 30 volts. This leaves 120 minus 30 or 90 volts as the potential difference between **B** and the other side of the line **E.** As we progress from **A** toward **E,** the line voltage is steadily decreasing until it is zero at **E,** and the line drop is steadily increasing until at **E,** it is 120 volts.

The voltages **A** to **E, B** to **E,** and so on, are more often designated as line voltage or potential difference, whereas the voltage from **A** to **B, A** to **C,** and so on, are known by such terms as potential drop, line drop, voltage drop, or IR drop.

An important point to note is that although **B** is negative with respect to **A,** it is positive to **C, D,** and **E.** In other words, any point along the conductor **AE** is positive to all points between itself and **E,** but negative with respect to all points between itself and **A.** This condition is made use of in refining copper as will be discussed more in detail later.

In making bus bar layouts and designing efficient plating racks, it is necessary to go a little more into detail regarding resistance of conduct-

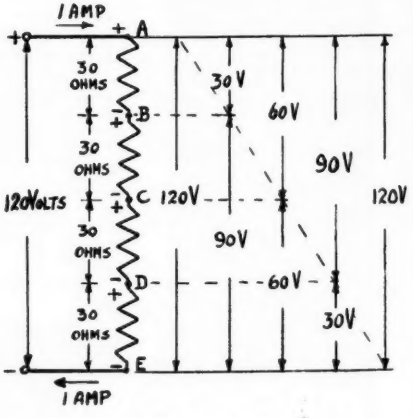

Fig. 18—Electrical drop in potential

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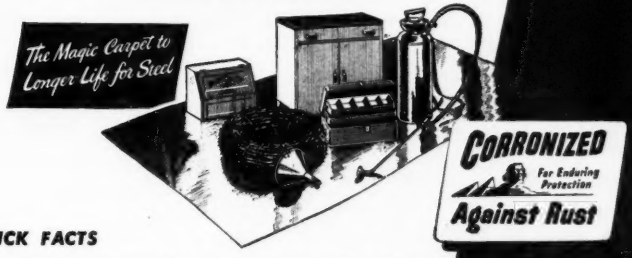

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Table II
Approximate Resistivity of Various Metals

Metal	Resistivity at 20° C. (68° F.) k = ohms per circular mil-foot	Relative Resistivity Copper = 1
Silver, pure annealed	9.60	0.93
Copper, annealed	10.37	1.00
Copper, hard drawn	10.60	1.02
Aluminum, 99.7% pure	17.05	1.64
Zinc, very pure	37.41	3.61
Brass	46.82	4.52
Phosphor-Bronze	55.16	5.32
Iron Wire	64.00	6.17
Nickel	84.00	8.10
Steel Wire	89.40	8.62

ors, especially those of copper. We have already given the general formula for finding resistance. The formula is $R = \frac{kL}{A}$ where **R** is resistance in ohms, **L** is length, **A** is cross-sectional area, and **k** is the constant of resistivity for the material comprising the conductor.

As was previously stated, this constant **k** may be expressed in many different ways, but the most useful for practical work defines **k** in ohms per circular mil-foot. For copper, **k** equals 10.37 ohms per mil-foot at 20 deg. C. (68 deg. F.).

This method of stating the value of **k** involves the use of cross-sectional area in terms of circular mils. The formula now becomes $R = \frac{10.37\ L}{A}$ where **A** must be expressed in circular mils and **L** in feet. Table II gives the values of **k** for various metals.

It now becomes necessary to discuss the meaning of the terms mil, circular mil, and square mil. Since most wire is drawn round, the calculation of cross-sectional area in square inches is too cumbersome, therefore, the circular mil has become the standard method of measurement.

The term "mil" shortened from "milli" means one thousandth. For instance, a millimeter is one thousandth of a meter length; a milligram, one thousandth of a gram weight in the metric system, and one mill in United States coinage is one thousandth of a dollar.

A mil in wire measure is a unit of linear dimension and is one thousandth of an inch. A circular mil, sometimes abbreviated to cm., is a unit of area and is the area of a circle whose diameter is one thousandth of an inch. The square mil is the area of a square one thousandth inch on a side. (See Fig. 19.).

Since the area of circles varies with the square of their diameter, it is only necessary to square the diameter of a circle expressed in mils to obtain its area in circular mils. (See Fig. 20.). Thus, a circle one inch in diameter has an area of one million circular mils, and a square one inch on a side contains one million square mils—1,000 × 1,000 = 1,000,000. This enables the formula for resistance to be expressed as follows: $R = \frac{kL}{D_2}$ where **D** is diameter in mils.

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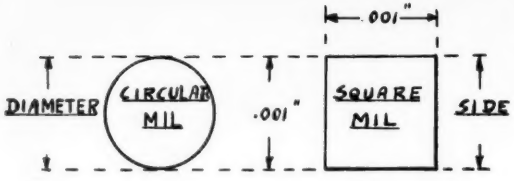

Fig. 19—Circular and square mil measurement

It is obvious that a circular mil is smaller than a square mil by the ratio of 3.1416 divided by 4 or 0.7854 to 1. Referring to Fig. 20, the area of the square is one square inch and it contains 1,000,000 square mils. The area of the circle is 0.7854 square inch, but it contains 1,000,000 circular mils, therefore, each circular mil is 0.7854 square mil and a square mil equals $\frac{1}{0.7854}$ or 1.273 circular mils. Now let us consider a few examples of the way in which this resistance formula can be useful.

(1) Suppose a pair of micrometers is used to measure the diameter of a bare copper wire and it is found to be 0.102 inch. This is 102 mils and the cross-sectional area is 102 x 102 = 10,400 circular mils. The resistance per foot is then $R = \frac{10.37}{10,400}$ = 0.000997 ohm or 0.997 ohm per 1000 feet at 68 deg. F. The question of change of resistance with temperature will be discussed later.

(2) Again, suppose a copper wire measures 0.010 inch or 10 mils diameter, then the cross-section is 100 circular mils and the resistance per thousand feet is $\frac{10.37 \times 1000}{100}$ = 103.7 ohms.

(3) Suppose we want the resistance of a bus bar 2 inches wide and 1/4 inch thick. The cross-sectional area is 2,000 × 250 or 500,000 square mils. Expressed in circular mils this is 1.273 × 500,000 or 636,500. Then $R = \frac{10.37}{636,500}$ = 0.000016 ohm per foot.

(4) Again, assume we want the resistance of 100 feet of aluminum wire having a diameter of 0.040 inch or 40 mils and a cross-section of 1,600 circular mils. From Table II we see that the value of **k** for aluminum is 17.05, then

$$R = \frac{17.05 \times 100}{1600} = 1.06 \text{ ohm.}$$

In the next article, we will deal with the effect of temperature upon the resistance of conductors and its related effects.

Rohco 20 and Rohco 50 Cadmium Electroplating Processes. A four-page folder containing detailed instructions on the use of Rohco 20 and Rohco 50 addition agents for cadmium plating has been prepared by R. O. Hull & Co., 1279 W. 3rd St., Cleveland 13, Ohio. Copy free upon request.

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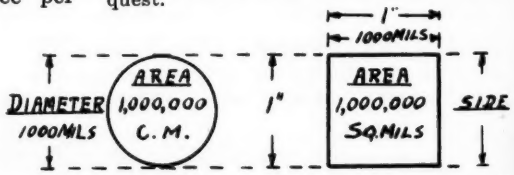

Fig. 20—Relation between circular and square mils

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Thiourea in Acid Copper Plating Solutions

By
WALTER BRENNER*
and
DR. C. B. F. YOUNG**

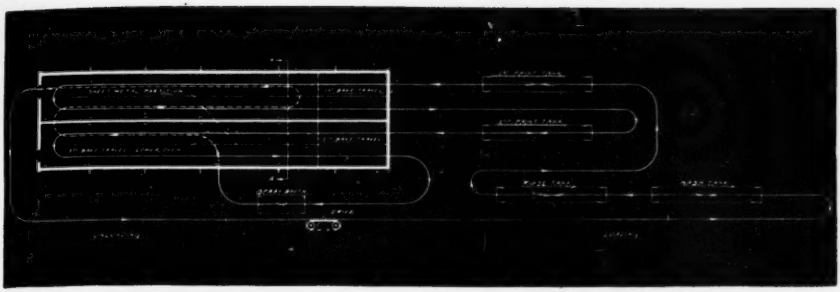
SINCE the successful introduction of bright nickel plating solutions to the industry, the subject of bright deposits has become of increasing importance to the man of vision in the metal-finishing field. The materials which aid the bath in giving these bright deposits have become more important. The substances which produce this phenomenon are commonly referred to as "addition agents." For almost every metal deposited from aqueous solutions there are certain substances, usually organic in character, which produce bright, fine grained, and hard plates of the metal to be plated, even when the addition agents are added in relatively small quantities (0.1 to 0.5 oz./gallon) to the plating solution.

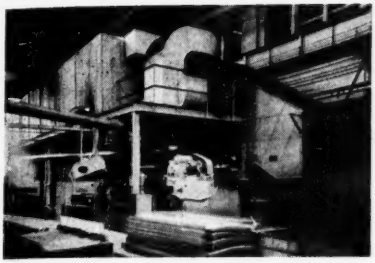
Many addition agents have been proposed for acid copper plating solutions and some have been used with varying success. Among them are phenol, phenol sulphonic acid, molasses, the polyethylene amides—patented brighteners[3], thiourea, gelatin, licorice, casein, and many others. Thiourea, because of its extremely interesting properties when used as an addition agent in plating solutions, has been used at various times in plating baths. For instance, L. R. Westbrook[2] proposed the use of thiourea and molybdates for bright zinc cyanide baths while Philipps and and Clifton[4] discussed the deposition of bright copper from a copper sulfate bath containing thiourea and molasses. In spite of the very good work by these and other investigators, our knowledge of the behavior of this addition agent in acid copper baths is still incomplete in view of the many variables affecting its action. The present paper is given so as to increase our knowledge and to present a comprehensive discussion of the effect of thiourea when used in acid copper plating solutions.

The practical significance of the use of a suitable addition agent for copper sulfate plating solutions has been demonstrated very clearly by Clifton and Philipps[4]. They calculated the loss of copper to the automobile industry due to buffing of ordinary "non-bright" plates prior to polishing and found it to amount to a total of 1,250,000 pounds (625 tons) of copper, assuming an annual production of 200,000 cars.

Thus, it will be readily understood that the study of any possible addition agent is of more than academic significance as bright deposits obviate to a large extent the necessity and

*Electrochemist, Columbia Recording Corp., New York, N. Y.
**Consultant, Head, Institute of Electrochemistry and Metallurgy, New York City.





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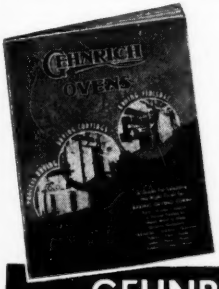

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cost of buffing operations together with the losses of metal incurred thereby and the subsequent polishing step with its inherent expense and difficulties.

Procedure

A conventional acid copper plating solution was made up as follows:

	Oz. per gallon
$CuSO_4 . 5H_2O$	32.00
H_2SO_4 sp. gr. 1.86	3.58

This was put into a hard rubber tank and then filtered twice to remove any suspended matter. Aliquot portions of standard solutions of thiourea were added to the plating bath. A copper anode was suspended from a copper rod and immersed completely in the plating bath. Similar suitable arrangements were made for the cathode plates, the area of which was determined in order to calculate cathode current density. Current was obtained from a small motor generator set; a rheostat arrangement provided a means of varying voltages and currents. After a suitable plating period, the cathodes were taken out and the deposits examined for brightness, smoothness, ductility, adherence, and so on. A ductile deposit was defined as one of about 0.001 inch thickness which when stripped from the cathode could be folded and creased without fracture. Brightness was roughly evaluated by comparison with an ordinary copper deposit and a bright nickel plate. The effects of varying the concentration of thiourea, acid, current density, temperature, and so on, on the physical characteristics of the deposit were studied and all the pertinent data taken and recorded. A minimum of two runs was made whenever a variable was changed. The standard bath was frequently renewed and tested periodically to ensure purity and uniformity of the solution at all times.

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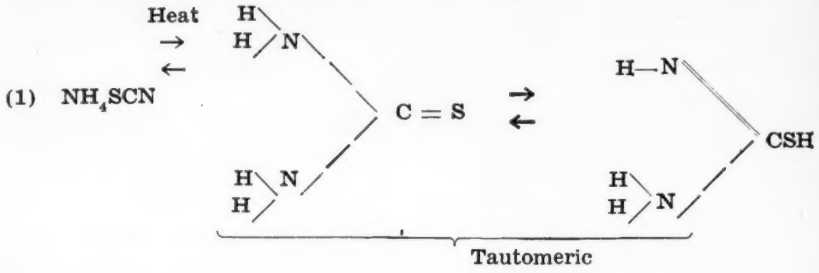
(MW 76.12) was obtained and recrystallized twice before use. It is a white crystalline solid with a melting point of 180 deg. C. and a density of 1.408. The solubility of the compound is 9.18 grams in 100 c. c. of water at 13 deg. C. It may be readily prepared from ammonium thiocyanate. When heated to 170 deg. C., ammonium thiocyanate rearranges to thiourea just as ammonium cyanate gave urea. A tautomer is in equilibrium with the compound as follows:[1]



Solid thiourea, it was found, could not be added directly to the bath successfully as most of the material went into solution and soon a voluminous gelatinous white precipitate formed. This, of course, settled to the bottom of the tank. If an aqueous solution of thiourea is added to the copper sulfate plating bath, some voluminous white precipitate is formed but can be redissolved with vigorous stirring. However, upon standing, the material which was precipitated and redissolved is slowly reprecipitated from the bath. It is gelatinous and gives a positive test for copper.

As has been suggested,[5] probably the tautomeric imide has precipitated cuprous copper as a mercaptide (see reaction 1). When the solution is left standing, the equilibrium of this reaction is slowly shifted toward the right with more of the compound rearranging itself to the tautomeric imide and then precipitating copper as the mercaptide. Thus, more of the precipitate mentioned above is formed and the effective life of the addition agent limited.

Increasing the concentration of thiourea in solution has been found to greatly hasten the rate of this tautomeric shift as did an increase in temperature. No quantitative relationship could be established because of the many difficulties present. For example, no method for the analysis for thiourea could be found, a statement in which Clifton and Philips[4] concur. Hendricks[5] suggests that a similar material is formed by cathodic reduction. This may explain the brightening action of the addition agent.

1. Effect of varying the concentration of thiourea in the bath. Aqueous solutions of thiourea were added to the "standard" bath mentioned above to give concentrations varying from 0.01 to 2.85 grams/liter of thiourea in solution and the physical properties of the plate studied. A summary of the results obtained follows in tabular form. The temperature of the solution varied from 70 to 75 deg. F. during the runs. It was noted that even a 5 deg. F. rise in temperature decreased the brightness of the deposits noticeably. Air agitation was found helpful in producing greater uniformity. The results of the runs are tabulated below.

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Table I

Run No.	Concen. $(NH_2)_2CS$ in Gm./L.	C. D. in Amp./Sq. Ft.	Deposit
1	0.00	15	Pink, smooth, fine grained, ductile, easy to strip,
		25	adherent
		45	
2	0.01	25	Very bright, smooth, fine grained, adherent, some
		45	loss of ductility, an increase in hardness, uniform
3	0.02	25	Same as 2 but again some increase in hardness
4	0.04	25	Mirror-bright especially at lower temperature (65° F.), smooth and fine grained, noticeable brittleness as shown by ductility test mentioned above, fair adherence
		45	Some streaks at higher c. d.
5	0.06	25	Bright deposit (less than above), increased brittleness and hardness
6	0.08	25	Less bright and more brittle, somewhat coarser grain, less uniform, fair adherence, more streaks at higher c. d., hard
7	0.10	25	About same as 6
8	0.14	25	Same as 6 but more streaks
9	0.20*	25	Some brightness but noticeable coarser grain, more brittle, less uniform, streaks, etc., especially upon prolonged plating
10	0.30	25	Rougher and more brittle, stripped with great difficulty
11	0.50	25	Salmon color shade of deposit, not very smooth or fine grained
		45	Streaks, brittle, peeling tendency especially upon prolonged plating

*Air agitation discontinued—see below.

When adding aqueous solutions of thiourea to give concentrations greater than 0.2 gram/liter, the white precipitate formed failed, in spite of vigorous and continued agitation, to dissolve completely. However, settling for 24 to 72 hours cleaned the bath of suspended matter; the greater number of hours were required for the larger concentration of addition agent. Air agitation of the bath was discontinued at this point in order to prevent stirring up of the already settled precipitate, causing thereby rougher cathode deposits.

From the table it may be seen that bright cathode deposits may be obtained with thiourea in concentrations of about 0.01 to 0.3 gram/liter with steadily decreasing ductility as the concentration of the addition agent is increased. Optimum brightness is obtained with concentrations of thiourea varying from 0.04 to 0.06 gram/liter. However, the brittleness and hardness of the deposits obtained in this range are appreciable although not excessive at 0.04 gram/liter. For practical work concentrations of 0.01 to 0.03 gram/liter are recommended.

Another important item is the effect of increasing the plating time or depositing heavier plates. In each case, it was found that plating to a thickness beyond 0.0015 to 0.0025 inch at the cathode current densities used

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appreciably decreased the brightness of the plate together with a corresponding increase in the brittleness and hardness of the deposit. At 0.005 to 0.008-inch thickness, the brightness had almost vanished but the brittleness remained and was much greater than that of thinner plates obtained at identical concentrations of thiourea. This feature makes the use of the addition agent definitely unsuitable for thick electroforming work. Its use in applications where only relatively small thicknesses are required, say up to 0.0015 inch, is perfectly feasible. Continued good results can be obtained only within the concentration range of thiourea discussed above.

It was found that beyond 0.2 to 0.3 gram/liter thiourea, no bright deposits could be obtain as shown above. At greater concentrations salmon colored deposits with increased brittleness and roughness were obtained. Part of the roughness was due to probably to the failure of the white precipitate formed by the addition of the aqueous thiourea solution to redissolve or settle completely. This has been discussed. At 0.6 gram/liter, the cathode deposit was so brittle and hard that the plate obtained could be shattered into several fragments which could be ground by hand into a fine powder with very little effort. Some gassing was observed, especially at the anode, probably due to decomposition reactions taking place at an increased rate. At 1 to 1.5 grams/liter, the deposit obtained was exceedingly brittle and very coarse grained, easily crumbling into a fine powder upon handling. The plate itself shattered into many tiny fragments when dropped. Adherence was poor. Intermittent gassing could be observed at the cathode.

Beyond 1 gram/liter, the deposits seemed to become less coherent, more porous, and so on, in increasing measure. At 2.85 grams/liter, no coherent plate could be obtained, instead, a milky salmon colored copper plate was obtained which readily fell from the cathode into the solution, splitting into various smaller fragments while doing so. Some long (2 to 3-inch) thin (¼ to ⅜-inch) pieces adhered very loosely to the plate and could be easily removed. These crumbled into a fine powder at the least provocation. It would be indeed interesting to investigate the behavior of such solutions at very high acidities and current desities (using perhaps rotary cathodes) at somewhat elevated temperatures from the point of view of producing metal powders.

2. Effect of increasing acidity of copper sulfate solution. Increasing the acidity from 3.58 to 7.51 oz./gallon (26.8 to 56.3 grams/liter of sulfuric acid of the solution decreased the brightness of the deposits about 25 per cent. Increased brittleness, roughness, and more streaks were also observed. At 10.54 grams/liter of sulfuric acid the brightness was lessened still further and very brittle and rough deposits were obtained. Again, the same results were obtained by a further addition of the material to give a total of 13.68 grams/liter in the bath. A greatly increased tendency toward peeling was noted as the acid content was increased beyond 8 grams/liter. The range of thiourea concentrations in which bright deposits could be obtained was not changed appreciably in any way by the addition of sulfuric acid. At 13.58 grams/liter, cathode polarization was greatly increased as evidenced by gassing and decrease of cathode current efficiency. The effect of longer plating time was more accentuated but otherwise as discussed previously.

3. Increasing current density. Greater cathode current densities proved helpful in obtaining more uni-

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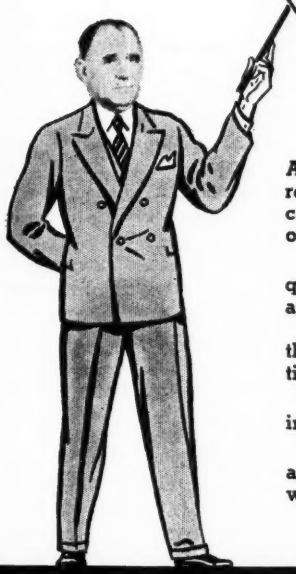

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formly bright and smooth deposits within the "bright range" concentrations as mentioned above. With thicker deposits, however, an increased tendency for streaks was observed as the current densities exceeded 40 to 45 amp./foot². At higher acid contents (10.54 oz./gallon or 79.0 grams/liter) an increase in current density (40 to 45 amp./sq. foot) did not seem to affect the quality of the plates obtained appreciably. At still higher current densities (70 to 75 amp./sq. foot) using stationary cathodes, rougher and finally "burnt" plates were obtained as was to be expected.

4. Agitation. Vigorous mechanical or air agitation is highly recommended as it results in a great increase in the brightness of the deposit, smoothness, and, above all, the uniformity of the deposits obtained within the bright range. It should most certainly be used together with greater current densities in order to obtain the best possible results. The difference in the quality of the deposits obtained with and without agitation is quite remarkable and again demonstrates the important role of agitation in many plating solutions.

Beyond 0.2 gram/liter thiourea, agitation had to be discontinued in order to prevent stirring up of the already settled precipitate and thus causing rougher deposits by occlusion of suspended matter from the solution in the metal deposit, as explained above. An increase in acidity decreased somewhat the effect of agitation of the bath on the cathode deposit. However, within the bright range the deposits obtained were greatly superior in regard to brightness, smoothness, and uniformity to those produced without the benefit of agitation at identical thiourea concentrations.

5. Temperature. An increase in temperature above 80 deg. F. greatly decreases the efficiency of thiourea as

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a brightening agent. At 100 deg. F. most of the brightness of the deposit was destroyed. As the temperature was raised over 100 deg. F., almost all of the effects obtained by the addition of thiourea were gradually lessened. At 110 to 120 deg. F., they were almost lost. It was noticed on removing the solution from the tank that a greater amount of precipitate had formed than formerly. This suggests that the tautomeric shift to the imide discussed above is greatly increased by a rise in temperature, resulting in almost complete transformation of the thiourea originally added to the bath to the insoluble mercaptide precipitate.

To test this theory, a fresh solution of identical concentrations was made up at 80 deg. F., agitated vigorously, and filtered thoroughly into a clean tank. The temperature of the resulting clear solution was then raised to 120 deg. F. Work was then plated for several hours at 25 amp./sq. foot. The solution was then removed from the tank. It was found that a rather heavy voluminous white precipitate had formed and was present in the bottom of the tank. Furthermore, the cathode deposits obtained did not show any of the characteristics usually associated with thiourea addition to any appreciable degree, all of which seems to support the theory advanced above.

Lowering the temperature of the bath produced greatly increased brightness of the deposits. Grain size was also found to have decreased while hardness increased somewhat. Optimum conditions for brightness were found at about 50 to 60 deg. F. At such temperatures, clear uniform mirror-like shiny deposits could be obtained without excessive brittleness using 0.03 to 0.06 gram/liter of thiourea addition and the thickness of the deposits could be up to 0.002 inch. Thicker deposits again showed a decrease of brightness. In commercial operation such low temperatures are not very desirable as the resistance of the copper sulfate solution is then appreciably greater, resulting in increased voltage and greater power costs. Also, the solution must be cooled mechanically which is expensive and not very practical. However, for good dependable results, the bath temperature should not be permitted to go much above 80 deg. F. A temperature of 70 to 75 deg. F. is highly desirable for best work. This may necessitate the introduction of cooling coils, particularly if high speed plating is desired, which is expensive.

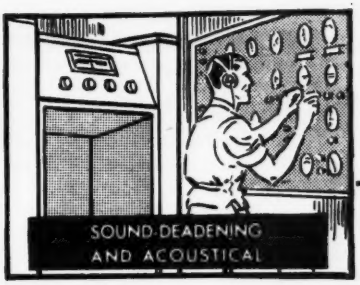
6. Molasses. A bath was prepared using the concentrations recommended by Clifton and Philipps[4]. This is given below:

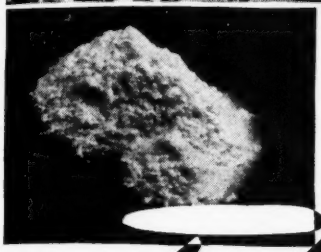
	Grams/liter	Oz./gallon
$CuSO_4 \cdot 5H_2O$	240.00	32.
H_2SO_4 Sp. gr.	33.75	4.5
Thiourea	0.03	0.004
Molasses	0.80	0.106

The temperature given by these authors was 75 deg. F. Work was plated at 25 amp./foot^2. The deposits obtained were somewhat finer grained and brighter than those resulting from a bath having only 0.03 gram/liter thiourea as addition agent. Their uniformity compared rather favorably with that obtained by straight thiourea additions alone. This effect[4] is explained perhaps on the basis that molasses as addition agent acts opposite to thiourea, especially reducing its tendency toward striations.

7. Anodes. During the course of the experiment, the anodes became coated with a fine powder of copper and/or copper oxide. This, however, did not seem to interfere with the smoothness of the deposits obtained.

8. Control. The quantity of thiourea present at a given time in the plating bath cannot be controlled by analysis as stated above. Visual in-





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spection of the deposits obtained is the most feasible method of maintaining the proper amount of the addition agent in solution as the physical characteristics of the deposits change greatly with only a slight change in the concentration of thiourea. If too much addition agent has been added to the bath, it can be removed simply by increasing the temperature of the solution to 100 to 120 deg. F., keeping the bath at this elevated temperature for one to three hours, and subsequent filtration. This procedure will serve to remove almost all of the addition agent originally added as the insoluble precipitate discussed previously. Unless the temperature of the solution is above 80 deg. F. or impurities are introduced, no trouble should be experienced in the proper running of the bath for extended periods of time. Additions of ammonium sulfate proved helpful in producing more uniform deposits. Chloride ions added as sodium chloride greatly reduced the brightness of the deposits obtained. The addition of molasses produced a finer grained and brighter deposit.

Conclusions

The addition of thiourea to the conventional acid copper plating bath as an aqueous solution produces bright and hard deposits. Concentrations of the addition agent varying from 0.01 to 0.03 gram/liter are recommended for best results without excessive brittleness. Greater concentrations result in greatly increased brittleness of the cathode deposits obtained with eventual loss of brightness beyond 0.2 to 0.3 gram/liter. Agitation and increased current densities are helpful in producing brighter, smoother, and more uniform deposits within the bright range. A sulfuric acid content above 8 oz./gallon is not desirable. Temperatures should be kept below 80 deg. F. (70 deg. F. preferably) as a loss of brightness results with increased temperatures. Control of the addition agent is best accomplished by visual inspection of the deposits. The co-addition of molasses produces smoother and more uniform plates while introduction of chloride ions results in loss of brightness. The mode of action of thiourea is not certain; probably the tautomeric imide is formed in acid solution which then precipitates copper as a mercaptide. This is also thought to result from cathodic reduction in the bath.

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[4]W. M. Philipps and F. L. Clifton, Proc. Am. Electroplaters' Society, 1942.
[5]John A. Hendricks, Transactions Electrochemical Society, 82, 113, 1942.

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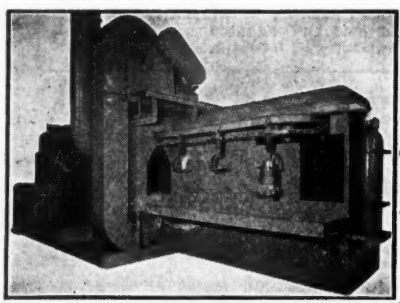

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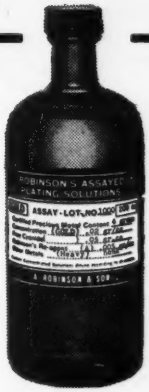

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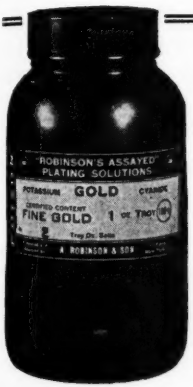

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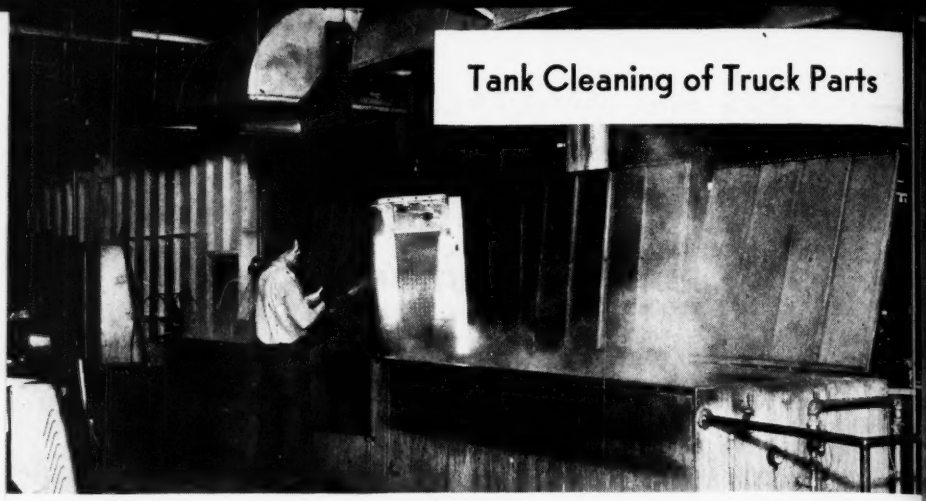

THE production program for military and civilian trucks requires speedy, thorough cleaning of thousands of parts prior to painting. The above illustration shows an excellent tank installation for handling truck hoods, fenders, aprons, and so on.

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Many of these parts are destined for truck-trailer units like the one shown below. Similar trucks now operating overseas transport tanks, half-tracks and so on, from one area to another and haul supplies of all kinds. In one of the war's greatest amphibious actions, they brought hundreds of landing craft and portable bridge equipment to the banks of the Rhine. —*Oakite News Service.*

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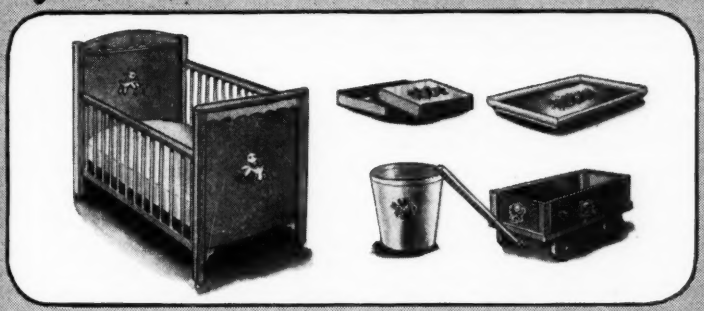

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Performance Tests for Metal Finishes

By BURR PRICE

AMERICAN industry got to be acutely "government-spec-conscious" in the war years. Writing of the specifications occupied a small-sized army in the services and Federal agencies, and the multitude of initialed-and-numbered documents gave many a violet headache to suppliers and production experts. Because a majority of these specs included performance stipulations, technical checking became the order of the day all down the line from the biggest suppliers and manufacturers to the smallest. Thorough testing of output was essential to guard against official rejection, which often would have been disastrous from the profit angle.

War-learned lessons on the value of technical checking should pay big dividends in peacetime, especially for the smaller manufacturers who have not always given sufficient testing to their products. In the field of specialized metal product finishing, it is obvious that surface protection and decorative features are factors of equal importance in the initial manufacturing process and that durability of both is vital in holding and expanding the sale of an item or a line in the keenly competitive markets of the next few years.

Laboratory and production room testing of protective coatings by their manufacturers has been developed to a high degree and research work is continuously conducted to improve paints, varnishes, lacquers and enamels, but there is every reason for a product manufacturer to again test the film on the finished article to guard against failures which can easily jeopardize its acceptance in the competitive field.

How big equipment manufacturers regard this point and check and double check against failure of a coating was vividly illustrated in an informal talk which the technical manager for one of the biggest in the electrical field made recently to a group in the protective coatings industry. He told them first that his company was always receptive to new materials; then, he told them to what strict tests they were put, and why. At the time, the company was turning out field equipment for the Army almost exclusively. Electrical efficiency was of course the first consideration, so that field communication would always be assured against interruption. As mentioned in a previous article by the author, protective coatings are a great factor in the preservation of electrical efficiency of such apparatus, and failure could not be tolerated.

But there was another reason, linked

with the postwar selling market. The instruments of that company were nationally known, nationally advertised and after the war they would again become popular consumer goods. Now, those instruments were being operated in the field by thousands upon thousands of young soldiers who on their return to civilian life would again become consumers, potentital buyers of the product. The company could not afford to send into the field instruments which would fail in any manner; first, because of the effect on the war effort, and, second, because of the effect on buyers of the future.

Mechanical Testing for Performance

The protective coatings industry and large users of its products have developed quite a number of machines for testing flexibility, toughness, abrasion resistance, mar resistance, scratch resistance and other properties of films. These machines are of value alike in the research and production departments of the paint, varnish and lacquer manufacturers and in the shops of the metal-finishing industry, which, judging by recent sales records, is coming to use them more and more.

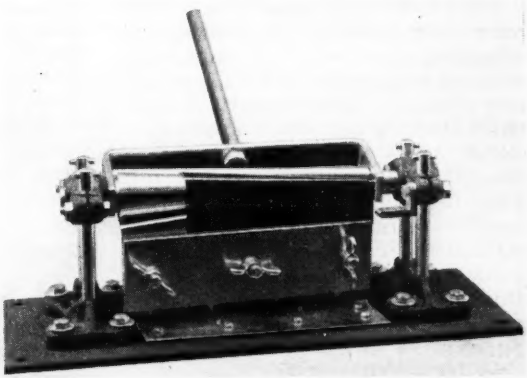
The Conical Mandrel

One of the wartime developments was the increase in the use of the conical mandrel for testing the flexibility of metal coatings. Conical mandrel tests were called for in many government specifications, and interest in them is carrying over into current operations. The instrument was developed some years ago by the Bell Telephone Laboratories, Inc., and is manufactured under license by Henry Zuhr, Inc., of New York City.

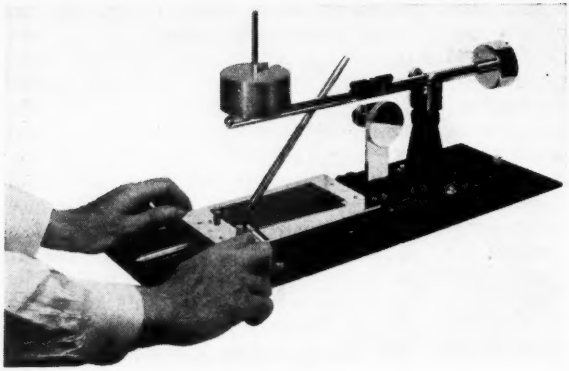
Simple mandrels have been in use for a long time. The first one was a small box-life affair with a crossbar at the top, over which the metal was bent and signs of checking were observed. Another earlier apparatus was one which merely stretched the film. Later, in order to obtain a range of elongations, or stretchings, a machine was developed incorporating six mandrels of different sizes ranging from ⅛ to 1 inch in diameter, in which six panels were bent simultaneously.

A disadvantage of this multi-mandrel machine was that the results were discontinuous, and, accordingly, the Bell Telephone Laboratories developed the conical mandrel, which was described by H. G. Arlt, of the Laboratories, before a session of the American Society for Testing Materials some years ago and which was adopted as a standard by the Society just before the war.

This instrument permits panels up to 1/32 inch in thickness to be bent



Conical mandrel manufactured by Henry Zuhr, Inc., under the license of Bell Telephone Laboratories, Inc. Tests of flexibility are made by wrapping panels up to 1/32 inch thick around the cone, which is 8 inches long and has a diameter of 1½ inches at the base and ⅛ inch at the apex.



Scratch adhesion and mar testing machine developed by Bell Telephone Laboratories, Inc., in which paint films are evaluated by pushing them beneath a rounded stylus mounted in a pivoted beam that is loaded increasingly until each film is stripped from its base or resists five kilograms

closely around the cone, which is 8 inches long and which has a diameter of 1½ inches at the base and ⅛ inch at the apex. The specimen is clamped between the cone and a drawbar, and is thus guided around the mandrel until it reaches an 180-degree bend. In this operation, a coating 0.001 inch thick over a smooth steel base 1/32 inch thick is elongated from 2.6 per cent at the base to 28 per cent at the narrow end. In accordance with predetermined formulas and depending on the nature of the film and the base metal, the point at which shadow marks, or incipient cracks, begin to show reveals the information needed on elasticity.

Early tests were made to provide a comparison between the conical and cylindrical mandrels, and data were obtained with regard to the use of lacquer films on 1/32-inch panels of cold-rolled steel, ¾ hard brass and for annealed brass. Conclusions reached were that the conical mandrel test gives the same results as the cylindrical mandrel test with the advantages of lower cost, simpler operating technique, and definite instead of limiting values. Also, the conical mandrel test is a useful tool in determining changes in flexibility of lacquer films due to different environments of temperature and humidity.

Scratch Adhesion and Mar Testing

One of the latest machines developed by the Bell Telephone Laboratories is one which evaluates the adhesion of paint films by pushing them beneath a rounded stylus mounted in a pivoted beam that is loaded increasingly until each film is stripped from its base or resists five kilograms. Determination of mar resistance is made by substituting a phonograph needle for the stylus and drawing the finish repeatedly beneath it, each successive time with an increasing load, until the upper surface of the film is ruptured. Operating technique is substantially the same for both testings. In the tests, finishing materials are usually applied to panels from ½ x 2 inches to 4½ x 6 inches in surface area and from 1/32 to ½ inch in thickness. After aging, the specimens are conditioned for at least twenty-four hours at 77 deg. F. and 50 per cent relative humidity prior to testing under the same temperature and humidity conditions.

R. J. Phair, of the Bell Telephone Laboratories, who has been active in developing testing machines for some years, gives the following description of how scratch adhesion and mar testing are conducted:

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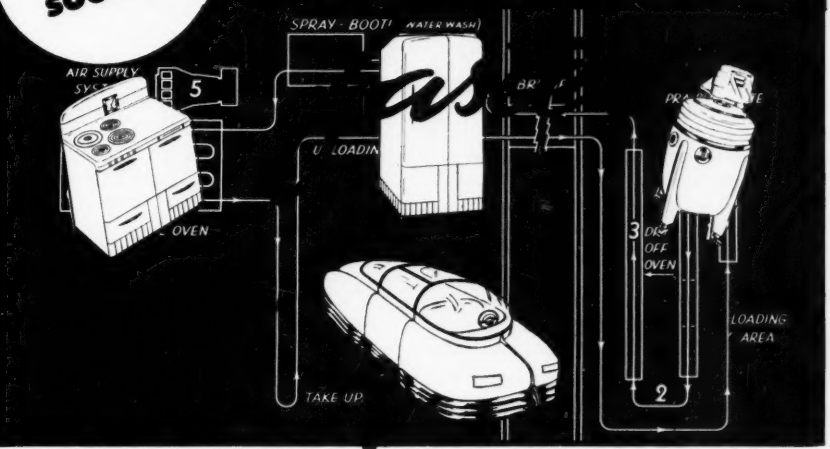

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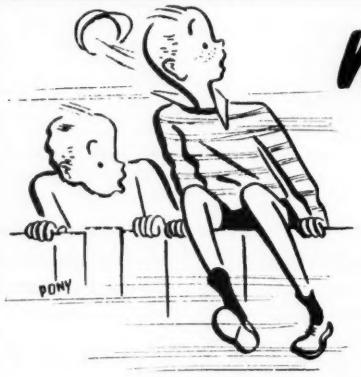
the set screws in its base, with the movable table directly in front of the operator. This puts the balance arm release at his right and permits moving the finish specimens readily under the scratching tool. After this tool has been mounted in its holder, which is set at 45 degrees to the horizontal, the balance arm is adjusted to a level position when the tool is in contact with the finish specimen. The adjustment is made by raising or lowering the entire pivot assembly at the main support column. Before weights are placed on the platform, the arm is raised and locked.

"The stylus for scratch-adhesion determination is made of 0.0625-inch drill rod carefully bent to give a 0.256-inch outside diameter. After bending, the steel is hardened, highly buffed and chromium plated. It is checked after each five hundred operations and replaced if any change in surface condition has occurred.

"In measuring scratch adhesion levels, the movable table, which slides on a ball-bearing support, is drawn toward the operator. The panel is then placed in position beneath the stylus and a minimum load of 0.5 kilogram is put on the balance platform. The arm is cautiously lowered until the stylus makes contact with the finish, which is then pushed with a slow steady pressure away from the operator. The balance arm is again locked in its raised position. This procedure is repeated with 0.5 kilogram increases in load until the film is removed and the base surface is exposed or until the maximum load of 5 kilograms has been attained. The panel is moved slightly to the side after each passage to bring a new section of the finish under the scratching tool.

"The term 'scratch-adhesion' is employed to define the minimum load in kilograms which causes removal of the film rather than the unmodified



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In only a few seconds—clean and dry. That's the secret of the success and universal acclaim of Blakeslee Solvent Vapor Degreasers. A patented and entirely different cleaning process for metal parts and alloys giving 100% grease-free surfaces. Even pores, cracks, seams and massed parts come through thoroughly clean and grease-free. Write for facts.

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Metal Parts WASHERS

STANDARD AND SPECIALS Engineered for you

G. S. BLAKESLEE & CO., CHICAGO 50, ILLINOIS
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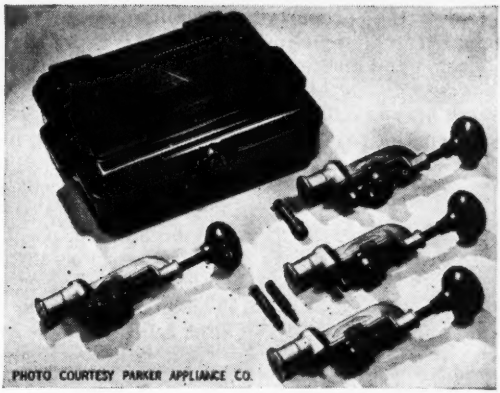

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DEEP-PENETRATING BLACK OXIDE FINISH

A Permanent 1-Bath Black for Steel & Iron

This single bath gives iron and all steels except stainless a dense, permanent black that won't rub off (penetration .0001"). Very flexible. Products may be formed after processing. Also an effective rust inhibitor and a fine bond for paints and lacquers. Chemical reaction at 300° F. Ordnance approved. There are also BLACK-MAGIC baths for zinc, copper, brass and cadmium.

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GLASS-BASE PROTECTIVE SPRAY COATING

Excellent protective and ornamental coating for steel lockers, radio equipment, mufflers, stove and heater parts and other steel and brass articles. Spray it on and dry at 200° F. Then bake at 350° F. in any industrial oven. Beautiful colors. Stands heat up to 1000° F. Highly resistant to corrosion, abrasion and impact. Navy and other approvals. Send for sample and full details.

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WITCH-DIP WITCH-OIL FINAL FINISHES

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SILCO PROTECTIVE COATING

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Cleaners Wetting Agents Acid Inhibitors Heat Treating Salts

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MITCHELL-BRADFORD

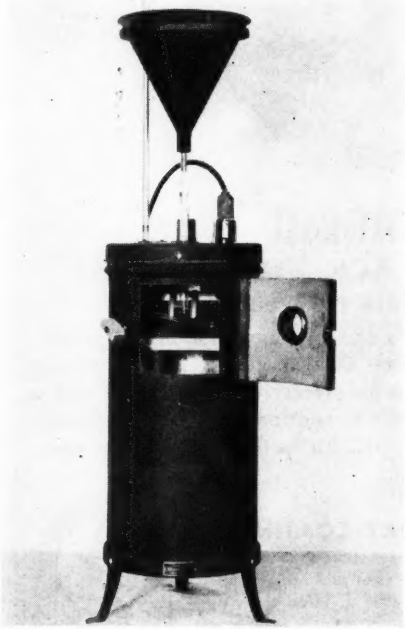
CHEMICAL COMPANY

MODERN METAL FINISHES

2446D Main St., Stratford P. O., BRIDGEPORT, CONN.

CHICAGO OFFICE: 111 W. Jackson Blvd. — DETROIT: June & Co. — CLEVELAND: Universal Paint & Varnish Co. — ST. LOUIS: G. S. Robins & Co. — INDIANAPOLIS: Stovall Equipment Co. — OAKLAND, CALIF.: Geo. A. Kushman Co.

word 'adhesion' since the property measured is associated with and influenced by the cohesion and plasticity of the coating as well as its adhesion to the base. Failures may result from poor adhesion between the paint and its base, which causes them to separate; deformation of the film by the scratching head to such an extent that the film flows away completely from under it, thus exposing the base; or poor cohesion of the film, which makes it disintegrate by powdering or crumbling under the stylus."



Abrasiometer for determining the abrasion resistance of coatings. The test panel is mounted in the machine on a stage which is set at 45 degrees to the vertical tube of the nozzle. The nozzle is then brought down in contact with the panel. In the test, the film is worn away at a spot directly under the exit end of the nozzle by a controlled carborundum blast.

In mar testing, Mr. Phair points out, the rounded tool is replaced by a chromium-plated needle. The procedure differs from that employed in adhesion testing in that the panel is drawn toward rather than away from the operator; a 50-gram minimum load with 50-gram increment increases is used; and the end point is reached when the upper surface of the paint film has been ruptured.

A breakdown point is distinguished from depressions in the finish by holding the marred specimen nearly at eye level in flat lighting so that no highlight reflections are visible. The least weight required to make a line which shows a distinct whitish reflection from the subsurface of the finish, but not from the base, is the mar value. Care is taken to avoid reflections from the side walls of depressions in the finish which are not cut through The mar point can also be observed by inspecting the marks under a microscope of 80 to 100 power.

In the case of the scratch-adhesion test, numerical values of from 0 to 1,000 grams are usually interpreted as poor; from 1,500 to 2,500 grams as fair; 3,000 to 4,000 grams as good; 4,500 to 5,000 grams as very good and above 5,000 grams as excellent.

Abrasion Resistance of Coatings on Aluminum

Another appartus developed by the Bell Telephone Laboratories which is simple in conception and operation is one which is designed for the determination of the abrasion resistance of oxide coatings on aluminum and of other organic and inorganic coatings by the air-blast abrasion technique. In describing this method before the American Society for Testing Materials, H. G. Arlt said:

"The extensive use in industry of oxide coatings on aluminum focuses attention on the necessity for suitable methods to test, determine and control the useful properties of these coatings. The research, design and manufactur-

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—the Best
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PLATING

Not so many years ago the Medicine Show "Doctor" had a big following. What happened to the "doctor of all trades" has happened in industry—particularly as regards the development, production and application of insulation for decorative plating racks and fixtures.

Industry has found that this is a job for specialists and engineers who devote their entire time to insulation problems of the electroplating industry.

For more than nine years our engineers have worked closely with electroplaters to develop the best insulation for racks and fixtures and that explains why so many of America's largest plating shops use BUNATOL.

The best rack insulation means lower cost-per-hour of use, less rejects and better production schedules. You can actually save money by using BUNATOL rack insulation.

Before you start decorative plating again find out about BUNATOL No. 720 and how it will help you.

NELSON J. QUINN COMPANY, Toledo 7, Ohio

BUNATOL

ENGINEERED INSULATION

ing problems involved can be greatly facilitated by reliable test methods for those characteristics which are definitely related to the methods of coating as well as to the use of anodically oxidized aluminum; that is, such properties as corrosion resistance, thickness, abrasion resistance, hardness and electrical breakdown."

The equipment he described, which in its perfected form is illustrated herewith, consists essentially of a glass nozzle in which the abrasive is mixed with air at controlled pressure and impinged on the surface of the specimen under test. The device is housed in a container to catch the used abrasive and is normally arranged for testing specimens up to 3 x 3 x ¼ inch. It is constructed with all the essential equipment mounted on the top of the container so that the coatings on larger specimens or full size parts can be tested by removing the top assembly and placing it directly on the part to be tested. An increase in the angle of incidence of the nozzle and specimen increases the abrasion value, and an increase in the distance between the nozzle and specimen also increases the abrasion value.

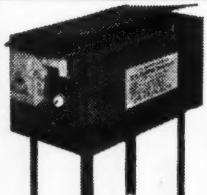
Results of the tests conducted with this appartus showed that it is not only valuable for research purposes but for commercial use as well. The abrasion-resistance and scratch-adhesion machines are also made by Henry Zuhr, Inc., under license from the Bell Telephone Laboratories.

(Photos Courtesy Bell Telephone Laboratories, Inc.)

American Blast Nozzles. Three grades of "Long-Lyfe" blast nozzles are tabulated and priced in a 12-page illustrated catalog published by the American Foundry Equipment Co., 525 S. Byrkit St., Mishawaka, Ind. Included are the following nozzles: (1) American-Norbide, guaranteed for 1,500 hours using steel abrasive; (2) American-Heanium, having a long-wearing ceramic insert; and (3) American V-Metal, made of heat-treated abrasion-resisting alloy steel. Copy of Catalog No. 27 free upon request.

"A Faster, Better Finishing Method for Metal, Plastic or Glass" is the title of a 12-page booklet published by the Minnesota Mining and Manufacturing Company which describes the 3-M Wetordry Method of precision grinding and finishing at high speeds. The booklet explains in non-technical language how this modern grinding and finishing method provides for a minimum of operating heat; greatly increases the life of the abrasive belts; and minimizes the hazard created by dust when grinding glass, ceramics, and certain metals.

Outstanding features of the booklet are numerous illustrations showing actual industrial applications of the 3-M Wetordry Method to problems frequently encountered in grinding and finishing of departments. Copy of the booklet may be obtained free of charge from the Advertising Department, Minnesota Mining and Manufacturing Co., St. Paul 6, Minnesota.



COOPER'S VICTORY TANK

For Cleaning Metals—Many Other Uses

(SINGLE AND DOUBLE MODELS)

NOW AVAILABLE! Wire Dipping Baskets, Electric Glue Pots, Wax Heating Tanks, Cold Processing Tanks, Gas Fired Tanks, Ethyl-Cellulose Tanks, Ethyl-Cellulose Compound, Dipping Wax (AXS 1015), Alkali Cleaners, Cleaning Solvents, Rubber Gloves and Aprons, Water Softeners, Rust Preventives, Rust Remover.

Electrically heated, thermostat control.

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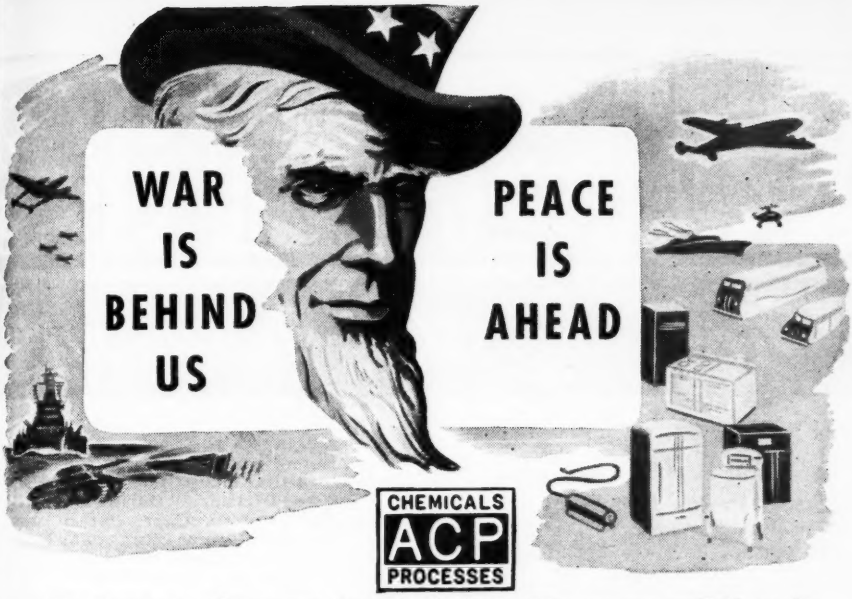

ACP Chemicals and Processes that helped win the War are now available to the metal-working industry to make more enduring the finishes on automobiles, farm machinery, refrigerators, washing machines and countless other necessities that will add comfort and pleasure to peacetime living.

210 A DEOXIDINE

Notable among these products is 210 A DEOXIDINE which has the distinct advantage of *cleaning* and *conditioning* at the same time; the combined operations are therefore carried thru in fewer stages — a saving in both time and equipment.

Power washers, heretofore used for alkali cleaning are satisfactory — also the large machines built especially for handling large production of large surfaces. Ordinary mild steel equipment is adequate — stainless steel is not required but may be used if already installed.

To Aid Rapid Reconversion

The simplicity of equipment and operation of 210 A Process will be a material aid to the metal working industry in reconversion to peacetime production. The low cost and excellent results obtained with DEOXIDINE for cleaning and conditioning were proved in wartime production. 210 A Deoxidine will be equally profitable to post-war producers.

ACP has served industry thru two World Wars and the intervening years of peace. This experience in the removal and prevention of rust, in inhibiting pickling baths and other applications of chemicals to the metal working industry is available to you to help speed your reconversion to normal production.

Our Technical Dept. will gladly assist you in the most effective application of our products to your manufacturing requirements. Write Dept. A-10.

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News of the Industry

F. H. Parkin Returns to Parkin Company

After completing 4½ years of service with the armed forces, Frederick H. Parkin has returned to his former position with The William M. Parkin Co., Pittsburgh, Pa., where he was employed for several years prior to his induction into the Army. The company is well known

Capt. Fredrick H. Parkin

for its cleaning compounds and inhibitors employed in the finishing processes of steel.

Recently honorably discharged from the Army with a total of 158 points, Capt. Parkin left this country in August 1942 and was among the first large contingents of American troops to land in England. Following a brief period of training there, he sailed to Africa and participated in that campaign as a member of the 34th Division. During the Argentan-Falaise trap, Capt. Parkin was cited with the Bronze Star award for leading a three man patrol which effectively trapped and forced the surrender of over 30 Germans of the 2nd Panzer Division.

Opens Branch Office

The Industrial Oven Engineering Company, Cleveland, manufacturer of ovens and oven processing systems, has opened a branch office in Chicago at 332 S. Michigan Avenue. In charge of the Chicago office are H. W. Munday and F. T. Greaves, both graduate engineers and specialists in industrial heating problems. Mr. Munday is a director of the Armour Research Foundation and a trustee of the Illinois Institute of Technology.

Elected Vice Presidents

The Hercules Powder Co., Inc., Wilmington, Del., announces that William R. Ellis and Mahlon G. Milliken have been elected vice presidents of the company. Mr. Ellis has been general manager of the Explosives Department and Mr. Milliken general manager of the of the Cellulose Products Department.

The company also announces the election of Philip B. Stull, now a vice president. Mr. Ellis and Mr. Milliken as members of the executive committee.

Produces New Synthetic Finish

New Wrinkle, Inc., Dayton, Ohio, announces a research development which has been made available to its licensees; namely, a new synthetic resin base wrinkle finish composition that requires no cooking. The new material can be applied in any desired textures by spraying, spreading, or rolling. The unusual flexibility of the resultant product enables such wrinkle finishes to be applied to cloth, felt, and other flexible materials as well as to metal.

N.P.V. & L.A. 1945 "Convention-at-Home"

Dates for the 1945 "Convention-at-Home" of the National Paint, Varnish and Lacquer Association will be Wednesday, October 31, Thursday, November 1, and Friday, November 2, president Ernest T. Trigg recently announced in a letter mailed to members of the industry. This will be the fourth consecutive convention by mail necessitated by wartime hotel and transportation conditions since the last regular convention was held in Chicago in 1941, and will constitute the 57th annual meeting of the association.

A "statutory meeting" for the election and other annual business will be held at association headquarters in Washington, D. C., as in the past three years, in conformance with the By-laws.

Assistant Manager of Market Research

George T. Collins has been appointed assistant manager of market research of the Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., according to an announcement by R. L. Davies, manager of market research. Mr. Collins, who received his B.S. in chemical engineering at Villanova College, was formerly associated with the Barrett Division of Allied Chemical & Dye Corporation. He is a member of the American Chemical Society, American Association of Textile Chemists and Colorists, American Institute of Chemists, and American Statistical Association.

In his new capacity, Mr. Collins will assist Mr. Davies in supervising the activities of the Market Research Department.

Joins Roxalin as Advertising Manager

Roxalin Flexible Finishes, Inc., Elizabeth, N. J., has announced the appointment of Robert Collyer as advertising manager. Mr. Collyer has been advertising manager for the Calco Chemical Division of the Textile Resin Department of American Cyanamid Company.

Robert Collyer

Mr. Collyer will supervise Roxalin's postwar promotion of product finishes and technical coatings engineered from the basic plastics and their co-polymers. He brings to the Roxalin organization wide experience in advertising, merchandising, and industrial design. His interest in packaging led to the wartime development of the life jacket dye marker used extensively by the Army and Navy to speed rescue at sea.

Before joining the American Cyanamid Company, Mr. Collyer was an advertising executive of the Chesapeake & Ohio Railroad and a member of several large New York advertising and printing firms.

Lea to Distribute Manderscheid Accessories

The Manderscheid Company announces the appointment of the Lea Manufacturing Co., Waterbury, Conn., as distributor of Presto polishing wheel bushings, semi-automatic tube polishing machines, balancing ways, and other Manderscheid polishing room accessories.

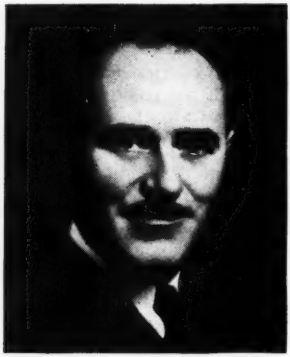
Changes Name

Earl L. Hess, vice president and general manager of Detroit White Lead Works announces that the corporate name of the organization has been changed to Rogers Paint Products, Inc. There will be no change in personnel or organization, the change in name being made to facilitate and simplify merchandising and streamline operations in step with modern trends.

Since 1880, the company has been marketing varnishes, enamels, automotive and industrial finishes under the trade name of "Rogers" after Colonel Ford H. Rogers, founder of the company.

New Director of Sales

O. J. S. deBrun, president of The Egyptian Lacquer Manufacturing Co., Rockefeller Center, New York, announces the appointment of Hugh C. Crawford as director of sales for the company, manufacturer of specialized production finishes for industrial users. During the past three years, Mr. Crawford has headed the War Production Division of the company.



Hugh C. Crawford

Director of Sales Development

The appointment of Thomas P. Cusack, Jr., as director of sales development is announced by the C. M. Hall Lamp Company, Detroit, manufacturer of automotive lighting and infra-red heating equipment. Until his new appointment, Mr. Cusack had been head of the company's infra-red heating division. Through his research work, papers published in technical journals, and addresses before engineering societies, he has been widely recognized as an authority on the industrial application of infra-red heating equipment.

Thomas P. Cusack, Jr.

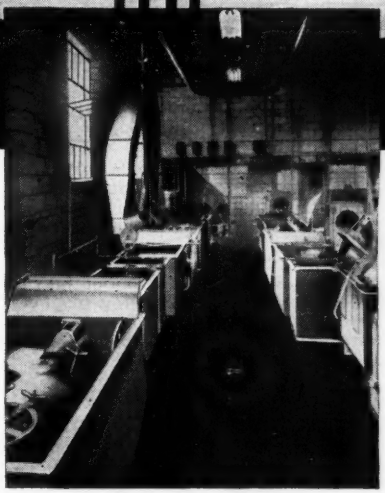
In 1940, Mr. Cusack joined the staff of the C. M. Hall Lamp Company as a radiant heating engineer and later became head of the entire infra-red heating division. Under his direction, the company plans not only increased efforts in behalf of its present products but also an expanded program for the development and marketing of lighting equipment in the aircraft, marine, industrial and domestic fields.

Mr. Cusack will continue to devote considerable time to Hall's infra-red division and counseling industry on production heating problems.

BETTER PLATING, LESS COST!
"MGC" ELECTROPLATING EQUIPMENT
Write for Interesting Details TODAY!
MOTOR GENERATOR CORP., HOBART SQ. PF-105 TROY, OHIO

MICCROLOID

The Most Effective Industrial Corrosive Resistant Yet Developed



Corrosion is no longer a serious challenge! . . . Years of chemical research has finally produced MICCROLOID—a tough, resilient, firmly adhering industrial synthetic coating—compounded from thromoplastic resins—offering practically impenetrable resistance to corrosion under the severest conditions where other coatings have failed . . . MICCROLOID is the product of the Research Laboratories of the Michigan Chrome & Chemical Company where experienced chemists have been attacking the problems of corrosion for years . . . MICCROLOID has been thoroughly tested under actual operating conditions and proven to be the most effective and most permanent protective yet developed . . . It may be brushed, dipped or sprayed—equally effective on metal, concrete and wood surfaces . . .

Chemists of the Michigan Chrome & Chemical Company and experienced field engineers are available to confer on all details incidental to the application of MICCROLOID to meet your specific needs.

USES OF MICCROLOID. It is intended for use on plating equipment, acid and alkali rinse tanks, structural steel, factory walls and floors, pipe lines, air ducts, blower equipment, ventilating systems, process piping and tubing, water storage, water softening and refrigerating equipment, food containers, photo equipment etc. Also exterior of tanks heated up to 150° F. and even far higher temperatures.

MICCRO Products

Write for detailed bulletin

MICHIGAN CHROME and CHEMICAL COMPANY

6340 East Jefferson Avenue • Detroit 7, Michigan

Reorganizes Eastern Sales Territories

To coordinate its expanded sales activities, United Chromium, Inc., announces a reorganization of Eastern sales territories and the appointment as district managers of three men who, through technical training as well as first-hand acquaintance with the everyday problems of platers, are well equipped to serve the industry.

Henry Mahlstedt has been named sales manager for the Eastern division, supervising all activities east of Buffalo, with headquarters in the company's New York offices. He is a graduate chemical engineer and before joining United Chromium in 1928, was chief chemist for the New York Steam Corporation and the Multiple Storage Battery Corporation. Mr. Mahlstedt's broad knowledge of the installation and operation of metal-finishing processes has won him wide respect among eastern manufacturers and job platers.

Meyer Shacat is now managing the New England district, making his headquarters a the Waterbury office and plant. A graduate of M. I. T. in chemical engineering, he spent a number of years in research and development work with the American Bosch Magneto Corporation and the Gould Storage Battery Company, joining the United Chromium organization in 1929 as a sales and service engineer.

Henry Mahlstedt

E. N. Riotte has been named district manager to supervise activities in New York, New Jersey, and Pennsylvania. Mr. Riotte, who will make his headquarters in the New York office, is a graduate of Yale University and has been active in sales and service engineering work with United Chromium since 1934.

FULL PROTECTION — LIGHT WEIGHT
LONG WEAR
NU-LITE
PLASTIC SLEEVES, GLOVES WORK APRONS

Provide full protection to workers from troublesome dermatitis induced by industrial irritants. Only 1/7th the weight of conventional protection garments — makes for wearer's comfort and freedom of movement—reducing fatigue.
NU-LITE sheds and resists water, oil, gasoline, strong acids, alkalis, degreasing and plating solutions.
Let us show you how NU-LITE's low cost protection features can boost production in your shop. Samples furnished for approval.

Safety Equipment, Production Aids and Packaging Specialties
NULITE PLASTICS
DEPT. PF VERONA, N. J.

Yerger Joins Lea

C. W. Yerger, formerly executive vice president of the Hanson-Van Winkle-Munning Company, has joined the executive staff of The Lea Manufacturing Co., Waterbury, Conn., and has been elected chairman of the board of directors.

Mr. Yerger is to develop postwar plans for the company as well as to assist in the production and distribution of its present products widely used in connection with burring, polishing, buffing, and plating and the general field of finishing of metal and non-metallic articles.

Appointed Assistant General Manager

Edward G. Crum, plant manager of the Hercules Powder Company Cellulose

A Beautiful Imitation

OF A REAL PLATED FINISH

Chrome Aluminum

Manufactured by us in a READY-MIXED Chrome Aluminum PAINT for dipping and spraying purposes: both airdry and bake.

We also can serve you with a Chrome Aluminum PASTE to be used in connection with quick bake synthetics or varnish vehicles, for the above purposes.

EDWARD C. BALLOU CO.

Bronze Powders—Aluminum Powders and Pastes

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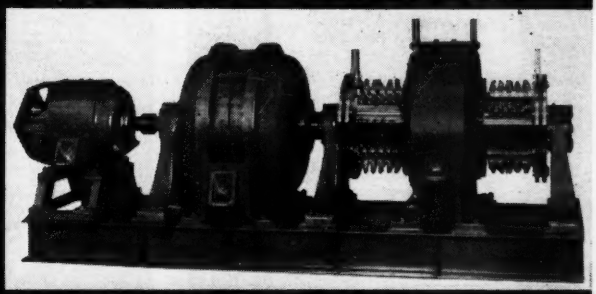
COLUMBIA **MOTOR GENERATORS**

for Electroplating and other Electrolytic Processes



Columbia Generators embody every feature essential for dependable, 24-hour operation. They are built for electroplating service in sizes of 6 to 20 volts, 500 to 20,000 amperes, for anodic treatment of aluminum in sizes of 40, 50, and 60 volts, 500 to 3,000 amperes. Columbia Generators for other electrolytic processes range from ½ to 250 KW, 100 to 40,000 amperes, 6 to 60 volts. Write for full information.

COLUMBIA ELECTRIC MFG. CO.

4519 HAMILTON AVE., N.E. CLEVELAND 14, OHIO

Chicago Office — 1525 E. 53rd St.

Products plant, Parlin, N. J., has been appointed assistant general manager of the Hercules Cellulose Products Department in Wilmington, Del. He succeeds John J. B. Fulenwider who was appointed general manager of the department August 31.

Edward G. Crum

Mr. Crum also will continue to discharge the duties of manager of the Parlin plant for the present. He has been associated with the plant since 1928 and has been manager since 1941.

Mr. Crum joined Hercules at Parlin immediately after graduation from Penn State University and served as laboratory chemist, assistant supervisor of the ester plant, shift supervisor, nitrating area supervisor, and dehydration area supervisor. He was sent to Europe by the company in August, 1936 to study methods of cellulose acetate production when Hercules started large-scale production of that material, and returned early in 1937 to head the newly-built cellulose acetate plant at Parlin as acetate supervisor.

Named Assistant Sales Manager

The appointment of R. L. "Mike" Cain as assistant sales manager of the Pennsylvania Salt Manufacturing Co., 1000 Widener Bldg., Philadelphia 7, Pa., has been announced. Mr. Cain attended Allegheny College at Meadville, Pa., and New York University. He joined Westvaco Chlorine Products Company in 1936

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External or Internal for every threaded and Machined Part.
PRECISION
Dust Caps & Thread Protectors
Most efficient, and economical.
Strong fibre, spirally wound. Close tolerance. No slipoffs. Formed crimped or perforated for irregular shapes. Transparent lumarith where visibility is required. Can be lettered or numbered for part identification.
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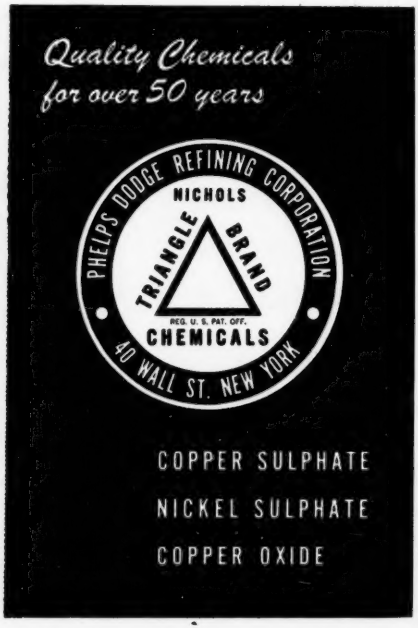
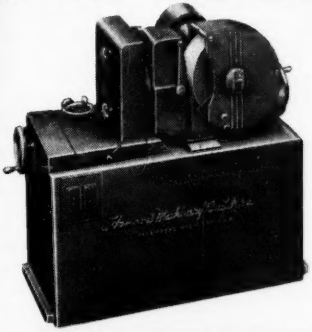


CYLINDRICAL "O D" GRINDING, POLISHING BUFFING MACHINE

Hammond of KALAMAZOO



FOR ⅛" TO 9" OUTSIDE DIAMETER TUBES RODS, BARS, VARIOUS CYLINDRICAL SHAPES

The Hammond "OD" will grind, polish or buff metals, plastics, fibre, etc. Desired finish attained by abrasive belt with backstand or polishing and buffing wheels. Send rough and finished samples for complete engineering report without obligation.

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SMALL • EFFICIENT • INEXPENSIVE • PRACTICAL

DUCON UNIT-TYPE DUST COLLECTOR *for dust control at machines*

Dust is a serious health hazard and wears out machinery bearings needlessly. DUCON solves these problems by stopping all the dust.

Compactness is combined with efficiency in DUCON design which features multiple numbers of cloth filter bags to provide maximum filter area to air flow.

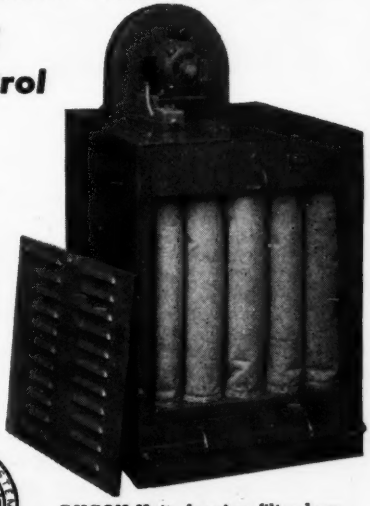
Filter bags readily cleaned by positive shaker and the dust thus dislodged drops to and accumulates in receptacle pan at bottom of unit. DUCON cloth filter bags last indefinitely providing low cost dust control without constant maintenance.

Complete information given in Bulletin No. 243. Ask for your copy.

THE DUCON COMPANY

Air and Gas Washers—Cyclones —Dust Control Systems

259 Norman Avenue
Brooklyn 22, N. Y.



DUCON Unit showing filter bag arrangement.
Capacities 200-800 Cubic Feet of Air per minute—four standard sizes.

where he was in charge of the New York district sales staff and was divisional sales manager of Curtin-Howe Corporation, an affiliated company.

In August 1942, Mr. Cain joined the Pennsylvania Salt Manufacturing Company as assistant to the director of sales. As assistant sales manager, Mr. Cain will continue his duties under Mr. Steele.

Barrand Joins H-VW-M

Harry P. Barrand has been elected a vice president and director of the Hanson-Van Winkle-Munning Co., Matawan,

Harry P. Barrand

N. J. He will devote himself to the financial work of the company.

Mr. Barrand was for a number of years a commercial and financial consultant and advisor, with broad experience with banking, investments, and corporation management. His experience has included banking and financial work abroad in Europe, South America, and Asia. A native New Yorker, Mr. Barrand is a graduate of the local public schools and high schools and also attended New York University.

Atkin Heads Westinghouse Lamp Training

The appointment of Charles H. Atkin as supervisor of employment and training for the Westinghouse Lamp Division has been announced by Charles F. Billings, manager of the division's industrial relations department. Mr. Atkin, who joined Westinghouse in 1942 as an interviewer in the industrial relations department, has been supervisor of employment since 1943. In assuming his new duties, Mr. Atkin has the additional responsibility of directing training and apprentice programs.

Mr. Atkin attended public school in his native Rochester, New York, and was graduated from the University of Rochester with a bachelor of arts degree in 1933. In 1935, he received his master of arts degree from Princeton University. Mr. Atkin has also done graduate work at American University, Washington, D. C., New York University, and the University of Newark (N. J.), in employment psychology and personnel counseling. He is a member of the New York Personnel Management Association.

Cooper Purchases Three-Story Building

D. C. Cooper, owner of the D. C. Cooper Co., 20 E. 18th St., Chicago 16, Ill., announces the purchase of a three-story building at 1467 S. Michigan Ave., Chicago. A two-story building will be erected on the vacant lot adjoining the newly acquired structure.

The three-story main building will be used in the manufacture of metal-cleaning and processing tanks and kindred electrical equipment. The new addition will be employed in the manufacture of alkali chemicals and other cleaning materials. Conveyors and other special equipment are being installed to facilitate the handling of products.

For a real good polishing job use

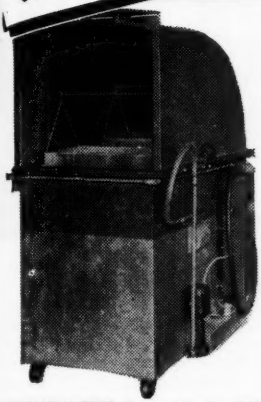
KEYSTONE EMERY

TURKISH — NAXOS — AMERICAN

KEYSTONE EMERY MILLS *Write for Sample* 4316 Paul St., Phila., Pa.

No Reconversion Worry Here!

PHILLIPS VAPOR DEGREASERS SPEED PRODUCTION QUOTAS



PHILLIPS VAPOR DEGREASERS clean ferrous or non-ferrous metals without pitting, scoring, or etching. Lowest toxicity, high efficiency, non-inflammable PHILLSOLV, used with a Phillips Vapor Degreaser, cleans 60 per cent faster—better—safer.

Phillips Vapor Degreasers are engineered in a wide range of needed sizes from portables up to mammoth heavy-duty conveyor degreasers handling 14,600 pounds per hour.

THE ONLY ALL-ELECTRIC DEGREASING MACHINE THAT RECLAIMS ITS OWN SOLVENT!

Phillips Vapor Degreaser reclaims its own solvent while the machine is in operation . . . no need to shut down for distilling!

Distributors in All Principal Cities.

Send for FREE Degreasing Manual — We make power spray washers, surge washers, stripping and dip tanks...a complete line of metal cleaning machinery.

BRAND NEW! Pictured is the Phillips ROTOMATIC Vapor Degreaser...conveyorized performance at open degreaser cost. Write for details.

PHILLIPS MANUFACTURING CO.

3439 W. TOUHY AVE. • CHICAGO 45, ILL.

An Investment in Sound Practice

FILTRATION

"Horizontal Plate" METHOD

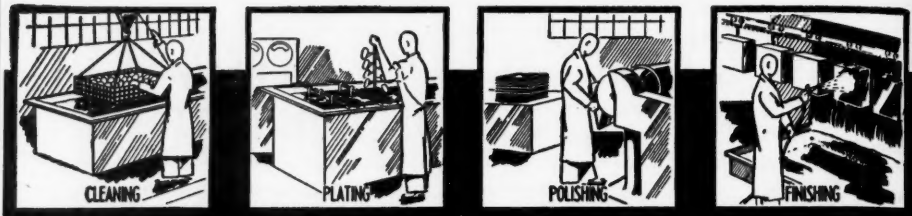
The test of any filter is the efficiency and speed with which it takes grit-laden, dirty plating solutions and delivers them pure, clean and transparent—*at low cost.* Sparkler Filters are scientifically designed to give superb and uniform quality filtering on all kinds of solutions. They completely remove all microscopic foreign substances and give a brilliance to the filtrate that is unbelievable when the filtered and unfiltered product are compared.

Take advantage of the free Sparkler filtration service. Our field engineer will call on request—no obligation.

50 to 10,000 G.P.H.

SPARKLER MANUFACTURING CO.

254 Lake St. Mundelein, Illinois



New Equipment and Materials

Despatch Type RS Industrial Oven

Available in sizes from 2 x 2 x 3 feet to 4½ x 6 x 9 feet, an industrial oven which is said to be adaptable for all baking and drying processes up to 500 deg. F. is now being manufactured by the Despatch Oven Co., 619 S. E. 8th St., Minneapolis 14, Minn. Designated as the Type RS, the oven is self-contained and requires only a lead-in of gas or electricity for complete installation. A special loading dolly and shelf arrangement allow for easy loading and maximum use. In addition, the upright design of the oven provides for a conservation of floor space, and automatic controls together with a quick-starting feature are said to make the unit readily adaptable from one type of operation to another.

According to the manufacturer, the Despatch Type RS Industrial Oven is now being successfully used in radio and radar, coil and armature drying and baking; carbon brittlement and aluminum aging; baking a variety of synthetic finishes, Japans, varnishes, lacquers, and enamels; and all kinds of dehydrat-

Despatch Type RS Industrial Ovens used for simultaneously baking and drying armatures

ing and drying. Special safety features and complete insulation are said to ensure comfort and health of the operator. Uniform temprature, high volume air flow, and controlled volatile exhaust are claimed to assure quality and uniformity of processing, as well as a reduction in baking time.

Pen-Kote 500 Paint

Designated as Pen-Kote 500, a general purpose maintenance paint for use in plating plants and other high-humidity areas is announced by the Peninsular Chemical Products Co., 6795 W. Nine Mile Rd., Van Dyke, Mich. The paint is unusually high in solids, thus, one coat often affords complete protection and two coats are claimed to be sufficient under the most difficult conditions.

Said to be as free-working as regular house paint, Pen-Kote 500 can be applied by the brush, dip, or spray method to brick, metal, painted, and other surfaces. According to the manufacturer, surfaces to be protected need not be dry or extra clean. Even when applied in the most humid atmosphere, the paint is said to dry to a hard, semi-gloss finish in 30 minutes or less. Hot surfaces can be painted as readily as cold surfaces, it is claimed.

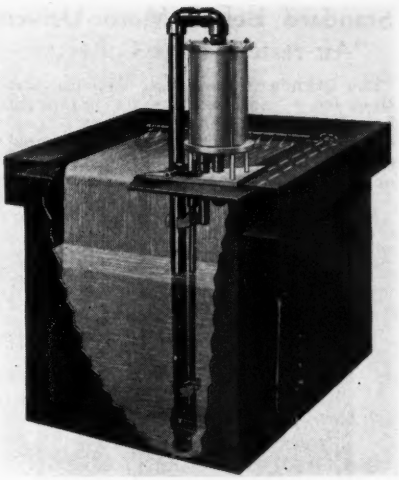
Odorless, Pen-Kote 50 can, it is stated, be quickly applied without discomfort to plant personnel or without shutdowns or interruption to production. The paint is described as extremely resistant to both acids and alkalis and as highly adhesive, flexible, and durable. According to the manufacturer, surfaces can be recoated as desired with the paint without peeling or blistering, and previous coatings of asphalt or any other paint will not work through since Pen-Kote 500 is an excellent non-bleeding sealer.

Pen-Kote 500 Paint is standardly available in medium gray, however. other colors can be obtained on application.

Nankervis Acid Lift

The development of an acid lift for use in the continuous skimming of acid dip tanks is announced by the George L. Nankervis Co., 5408 Commonwealth Ave., Detroit 8, Mich. The unit has no moving parts and is designed for operation by means of 6 lb. of air pressure.

Built entirely of corrosion-resistant materials — saran and micarta pipe and



Nankervis Acid Lift

cylinder with stainless attachments—the Nankervis Acid Lift is said to keep the solution clean, constantly and automatically, without the necessity of shutdowns for skimming. Thus, a continuous dipping schedule may be maintained without danger of fouling with unskimmed greases and oils, it is claimed.

Light in weight and economical to operate, the Nankervis Acid Lift can be easily installed on any dip tank with sump arrangement.

Pennsalt PRF Cement

Designed specifically for use in bonding corrosion-proof brick and tile where both acids and alkalis are encountered, a resin-type cement to be known as Pennsalt PRF Cement has been developed by the Special Chemicals Division, Pennsylvania Salt Manufacturing Co., 1000 Widener Bldg., Philadelphia 7, Pa. It is described as a quick-setting cold-hardening acid, alkali, and solvent-proof product consisting of a liquid and a powder which, when mixed, react chemically to form a cement.

Pennsalt PRF Cement is claimed to be ideal for use in laying floors and drains and in lining tanks in electroplating shops where a cement is required that will resist corrosive acids, alkalis, and solvents.

Standard Belted Motor-Driven "Air-rester" Dust Collector

The Standard Electrical Tool Co., 2518 River Rd., Cincinnati 4, Ohio, announces the addition of a belted motor-driven collector to its line of "Air-rester" dust collecting equipment. Designed primarily for operation on 25-cycle current, the

Standard Belted Motor-Driven "Air-rester" Dust Collector

unit is also available for use with 60-cycle current.

Compactly constructed, the Standard Belted Motor-Driven Air-rester can be used for the collecting of dust from all types of grinding, buffing, and polishing machines. The lower compartment of the unit contains a suction fan with motor, while an ample size dust collecting chamber is provided on the top of the unit. The dust collecting chamber is fitted with filtering pads for arresting the dust and allowing the exhausted air to leave the stand without perceptible dust at low velocity and without creating any objectionable draft or air movement. A convenient clean-out door is provided at the side of the dust collecting chamber,

The Standard Belted Motor-Driven Air-rester is available in two sizes: AR-14B with ¾ h.p. motor, 450 c.f.m capacity, and dimenions of 24 inches wide x 19 inches deep x 52 inches high; and AR-24B with 1½ h.p. motor, capacity of 1,000 c.f.m., and dimensions of 24 inches wide x 23 inches deep x 59 inches high.

"Gunk" P-96 Spray

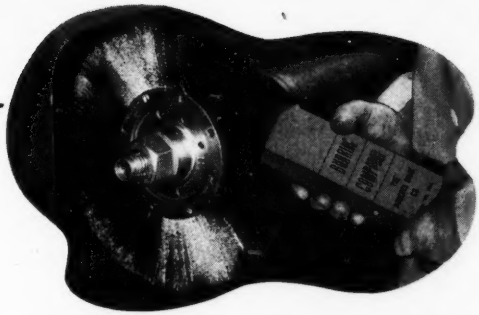
A self-emulsifying solvent for washing away grease, to be known as "Gunk" P-96 Spray, has been placed on the market by The Curran Corp., Malden 48, Mass. Applicable with spray gun or brush, the material provides a clean, milky, stable emulsion (oil-in-water type) which is said not to clog sewers or to present a fire hazard.

Gunk P-96 Spray is supplied as a concentrate or as special compounds scientifically formulated to meet a wide variety of individual performance requirements in the automotive, aircraft, and industrial fields. One gallon of concentrate when diluted with petroleum distillate is said to make ten gallons of Gunk P-96 Spray.

"Alumox" Aluminum Treating Process

The Enthone Co., Dept. PF, 440 Elm St., New Haven 2, Conn., announces a process for chemically treating aluminum and aluminum alloys which is said to produce a corrosion-inhibiting coating that serves to protect the aluminum against corrosive atmospheres such as salt spray and also presents an excellent base for organic finishes. Known as the "Alumox," the process is claimed to be particularly suitable for non-copper containing aluminum alloys. On such alloys, coatings can be obtained with a salt spray resistance of 250 or more hours.

The Alumox Process requires no electric current and consists in immersing the aluminum in a dilute solution of Alumox salts operated near 210 deg. F. from 2 to 15 minutes. The finish obtained is grayish-green, which is described as an attractive finish in itself.



SPEEDS BURRING • PRODUCES FINER FINISH

The most expensive item in finishing metal products is the polishing operation.

ROBERTS ROUGE PRODUCTS offer proper selection of rapid cutting compounds, made with binders which lubricate properly reducing friction and wear on the wheels. Adheres to wire wheels as well as Tampico wheels. Thus cutting the polishing operation to a minimum.

Send for a trial offer of Roberts Rouge Products, use it on the next polishing job and notice the difference.

ROBERTS ROUGE CO.
STRATFORD • CONN.

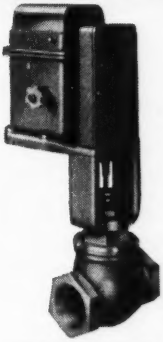
BARBER-COLMAN

MICRO SYSTEM *for* FINISHING CONTROL

REMOTE BULB MICROTHERM

Plating tanks, anodizing baths, and many other finishing operations where uniform temperature must be maintained, can be improved by using the Barber-Colman automatic electrically-operated "MICRO System" of temperature control equipment. Features include simple construction, no relays, and maximum power at all points of the valve stroke: "Hunting" is eliminated and the valve is positioned quickly with "micrometer accuracy."

Write for Bulletin
"CONTROLS FOR INDUSTRY"

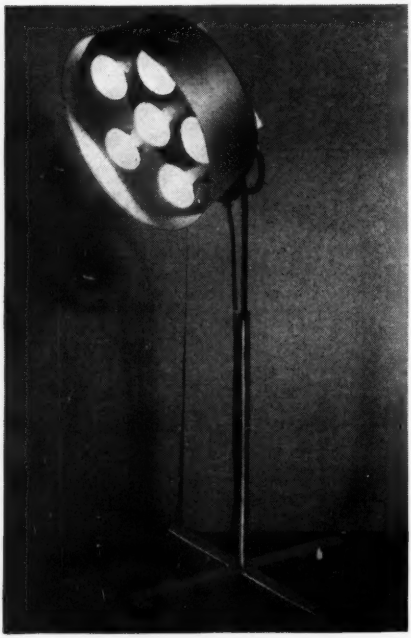


PROPORTIONING VALVE

BARBER-COLMAN COMPANY
1248 ROCK ST. • ROCKFORD, ILL.

Carbomatic Portable Infra-Red Unit

The Carbomatic Corp., 117 W. 63rd St., New York 23, N. Y., announces the availability of a portable infra-red unit for use with 125, 250, or 375-watt reflector type (R40 or RE40) infra-red or drying lamps. Designed for maximum flexibility, the unit may be used for a wide variety of applications where heat is desired in baking, drying, evaporating, preheating, and so on.



Carbomatic Portable Infra-Red Unit

The Carbomatic Portable Infra-Red Unit is available in two models designated as the W6 and the R12. The Model W6 utilizes six lamps, whereas the Model R12 utilizes 12 lamps. Both models are rigidly constructed of heavy gauge metal and are said to lend themselves ideally for fast, efficient operation in the smaller industrial plants, repair shops, paint shops, and so on.

Ipco Full Vision Dust and Spray Hood

Designed to afford complete head protection on the many jobs and operations involving dusts and paint sprays and, at the same time, allowing for normal, unrestricted vision, a full vision dust and spray hood has been added to the line of Ipco safety equipment offered by the Industrial Products Co., 2820 N. Fourth St., Philadelphia 33, Pa. The plastic window included in the design of the hood is of heavy gauge (0.040 inch) for impact resistance and can be quickly and easily replaced when necessary without the use of tools.

Made for wearing with or without correction glasses, the Ipco Full Vision Dust and Spray Hood is available in four types designated as the GA-200, GB-200, GB-55, and GB-1. The Type GA-200 is recommended for short period use where the dust volume is so great as to make breathing for any length of time impossible without some air filtering device. This type is made so as to extend down over the shoulders and fasten under the arm pits and can be used for boiler cleaning and similar

For a Chemically Clean Surface on all metals

PERMAG Cleaning Compounds

dependable • quick in action • economical
never injure soft metal surfaces

PERMAG Compounds have solved difficult metal cleaning problems. In the reconversion era you will need this help. *May we send you more details?*

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Main Office: 50 Court St., Brooklyn, N. Y.
In Canada: Canadian Permag Products Ltd.
Montreal - - - - Toronto

Ribbed with Steel

these rugged
WORK-HANDLERS
Protect and Save

• Steel-ribbon reinforced from finger tips to bottom of palm, these tough chrome tanned cowhide gloves give maximum protection and service in handling sharp-edged, rough, jagged parts or materials . . . sheets, bars, boards, stampings, castings, scrap, etc. They save time, speed work, save hands. Or what's your need? Over 4300 proved safeguards, gloves, mitts, aprons, leggings, etc., in Steel-Grip line. Used by big industrials since 1910. Write for catalog today.

INDUSTRIAL GLOVES CO.
7152 Garfield Blvd.,
Danville, Ill.
(In Canada: Safety Supply Co., Toronto)

STEEL GRIP
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Calibrated FACTS on WEARABILITY

Yours in Advance with the Taber Abraser

● No need for guesswork in the testing of your own or competitor's products for wearability or resistance to surface abrasion. The Taber Abraser gives you the facts with scientific precision—yet the procedure is as practical as it is accurate. Eliminates time-consuming, expensive performance tests. Used by hundreds of manufacturers and research laboratories for testing surface wearing qualities of paints, lacquer, plastics, leather, rubber, paper, electrotypes, etc.

Write: Full details on the Taber Abraser and the Taber wear testing method described in new handbook. Write for your free copy.

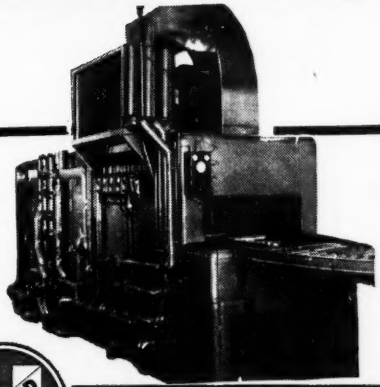
TABER INSTRUMENT CORPORATION
111PF Goundry St., N. Tonawanda, N. Y.

The Taber Test *Proves* What Wears Best!

Curtiss-Wright *selects*

HOWARD *Conveyor Wash Machine*

to clean PARTS PANS



• For war and pre-war production, HOWARD machines have completely solved the cleaning and finishing requirements of manufacturers, large and small. For your peacetime needs Howard machines can offer you many advantages to save time, manpower and money. Write for detailed literature and information.

Machinery for Pickling • Tumbling
Deburring • Washing • Quenching
Drying • Burnishing

HOWARD

HOWARD ENGINEERING & MFG. CO.
2237 Buck Street • Cincinnati 14, Ohio

operations, for cleaning certain classes of electrical apparatus, and so on. It

Ipco Full Vision Dust and Spray Hood

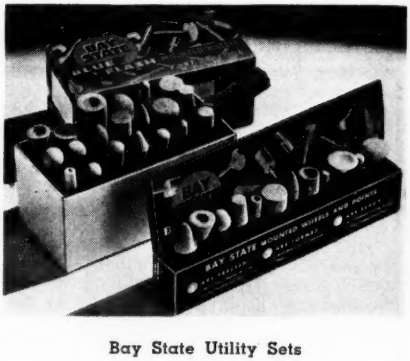
is fitted with a Bureau of Mines' approved type respirator with long life filter.

The Type GB-200 is recommended for long period operations where the concentration of dust is not so heavy. Slightly different in design from the Type GA-200, this hood is made so as to extend just below the shoulders and is fitted with a ventilating flap at the back which may be opened at intervals to provide for freer circulation of air on the inside. It is equipped with a Bureau of Mines' approved type respirator with long life filter.

The Type GB-55 is the same as the GB-200 except that it is fitted with a respirator that is more adaptable for paint spray and general nuisance dusts. Likewise, the Type GB-1 is the same as the GB-200 except that it is fitted with a chemical cartridge type respirator for the absorption of fumes given off in spraying lacquers and enamels.

Bay State Utility Sets

A compact package of 12 mounted wheels and points in sizes most com-



Bay State Utility Sets

SOL-KLEAN
for
Better Paint Adhesion
INDUSTRIAL CHEMICAL PRODUCTS CO.
DETROIT 7
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WE RECOVER YOUR
SOLVENTS and THINNERS
from Sludge, Waste, Wash, Spoiled Lacquers, etc.
AND SAVE YOU MONEY
Each shipment—one drum or a carload—receives PROPER and SEPARATE TREATMENT.
Solvents recovered by the Lefgren Process.
Write to:
SOLVENTS RECOVERY SERVICE, Inc.
1019 Broad St. or Newark, N. J.
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241 Brunswick St. Hammond, Ind.

ALLWOOD
"Vienna Brand" Lime
Made from Limestone that is identical in chemical analysis and geological structure with European Imported Lime. Tests show a "lime cake" made from Allwood "Vienna Brand" Lime equals the finish made from imported lime.
WRITE FOR FULL PARTICULARS
ALLWOOD LIME COMPANY
Manitowoc **Wisconsin**

monly used is now being offered to industry as a supplement to its present utility set of 20 mounted wheels and points by the Bay State Abrasive Products Co., Westboro, Massachusetts.

These utility sets are colorfully and protectively packaged in narrow one-piece boxes for the set of 12 and in two-piece packages for the set of 20 mounted wheels and points. A red and blue design treatment against a shiny black background affords easy identification of these products on the shop stock shelves.

Penetone Degreasing Material

A highly efficient degreasing and cleaning medium which is said to contain no ingredients that are toxic, inflammable, or injurious to the skin is now being marketed under the trade name of Penetone by The Penetone Co., Tenafly, N. J. The material can be used either for the degreasing of metals, machinery, and equipment or as a cleaner for flooring, and so on.

As a degreaser for metals and machinery, Penetone is available in two formulas, the standard Penetone being suitable for more than 80 per cent of all applications including all degreasing jobs where the lighter types of greases and oils are used as well as general maintenance. "Penetone Senior," a stronger concentrate, is recommended for use on heavy oils and caked-on greases.

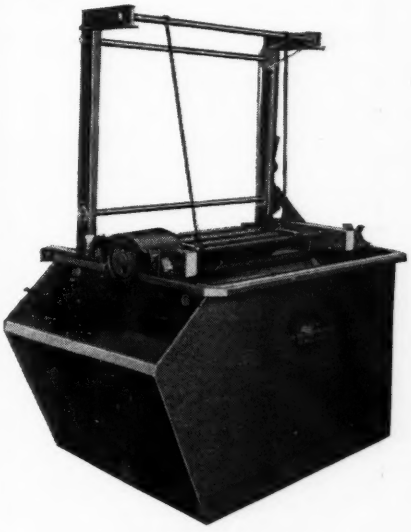
According to the manufacturer, the formulation of Penetone is such that by rapid emulsification and the ability to decrease surface tension, oil, grease. and adhering dirt are quickly loosened and removed. Small metal parts to be cleaned should be placed in a bath consisting of a solution of one part of Penetone to ten parts of water. In the case of light bodied oils, either warm or cold solution may be used. The heavy oils require a solution heated to approximately 180 deg. F., while rinsing may often be eliminated. It is frequently advisable that the rinse be of the same temperature as the degreasing bath. In the case of large parts, the grease may be removed by wiping with rags moistened with the diluted solution.

Another Penetone product known as "Major" is recommended for heavy duty degreasing where an extremely po-

NU-WHITE

OFFERS

SAVINGS in both Manpower and precious Time . . . by using a unit with OUTSTANDING FEATURES! Permits heavy loads . . . all conductors, tanks, rods, connections and switches have ample current carrying capacity . . . Cylinders constructed from heavy laminated bakelite are standard in all barrels.



NU-WHITE PRODUCTS CO.
2288 University Ave.
ST. PAUL 4, MINNESOTA

tent preparation is required. This concentrate is combined in the ratio of one to seven with kerosene for certain purposes; in the same ratio with water for other purposes, and, again, one part of the concentrate to seven parts of water and seven parts of kerosene for still a wider variety of uses and applications.

These various Penetone products are also recommended for use in cleaning the floors under machinery, as well as garage and grease rack floors, and the chassis and wheels of trucks and automobiles.

Opportunity Section

WANTED

Man to operate spraying equipment for varnishing and lacquering hardwood caskets. Steady work and good wages. Location in small town in northern New York. State experience and training in wood finishing, age and if married or single. Write Box No. 106, in care of Products Finishing, 431 Main St., Cincinnati 2, Ohio.

DISTRICT REPRESENTATIVES WANTED:

To represent a Southern manufacturer of phosphate processing materials, pickles, acid and alkali cleaners for cleaning, conditioning, rust proofing and as a paint bond on metals prior to finishing. Technical staff of engineers and laboratories maintained for use of manufacturers to assure highest performance and to assist sales representatives. Quicker delivery of materials and less freight permitting lower delivered prices for Southern manufacturers. Write us giving qualifications. Representatives wanted in territory centering around Dallas or Houston, New Orleans, Memphis, Jacksonville. Write Box No. 107, in care Chattanooga, Louisville, Richmond and of Products Finishing, 431 Main St., Cincinnati 2, Ohio.

Sales Engineers Wanted

Established company requires one or more additional sales engineers in their rapidly expanding oven department. Applicant must have had thorough experience designing and selling ovens. Give complete educational and experience history, state salary expected and send recent photograph. Write Box No. 101, in care of Products Finishing, 431 Main St., Cincinnati 2, Ohio.

Manufacturers' Representative Available

Experienced agent with wide acquaintance wishes to represent progressive manufacturer of mechanical equipment in Eastern territory. Write Box 103, in care of PRODUCTS FINISHING, 431 Main St., Cincinnati 2, Ohio.

WANTED

Slightly used or good condition 25 Packer Automatic machines. State age, type and serial number.

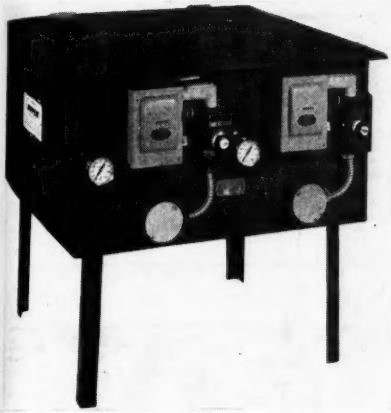
Jackson Buff Corporation
21-03 41st Ave., Long Island City, N. Y.

SALES EXECUTIVE WANTED

Large well-known chemical and cleaning products manufacturer doing national business, has permanent position open for experienced sales executive.

Must have a thorough knowledge of metal cleaning and finishing operations and have had at least 5 years experience in managing men. This is a position of great responsibility and carries compensation accordingly.

State qualifications fully. Will be treated confidentially. Box No. 102, Products Finishing, 431 Main St., Cinnati 2, Ohio.



Cooper Double Victory Tank

Cooper Double Victory Tank

Especially built for economy in operation and speed in production, the Cooper Double Victory Tank illustrated herewith, product of the D. C. Cooper Co., 20 E. 18th St., Chicago 16, Ill., is described as two complete tanks in one. The unit is so designed that one side can be used for cleaning metals and the other side for rinsing, or one side can be used for wax dipping and the other for rust preventives.

The Cooper Double Victory Tank is electrically heated, and each side has separate heating elements, thermostat, thermometer, brass drain cock in the bottom and overflow drain near the top. The full liquid capacity of each side is 20 gallons.

Udylite Buffs, Wheels, and Compositions are the subject of a six-page folder issued by The Udylite Corp., 1651 E. Grand Blvd., Detroit 11, Mich. The folder illustrates and describes a wide variety of buffs for every buffng requirement, as well as a complete line of polishing wheels and compositions, including chrome rouge, greaseless compound, emery paste, stainless steel compound, jewelers rouge, polishing wheel grease sticks, white coloring compound, emery cake, plastic buff compound, white lime nickel finish, and Tampico burring compound. Copy free upon request.

FORM-A-ROC - W

A Perfected White Alkyd-amine Baking Enamel

Complete hiding power, great adhesion, remarkable flexibility coupled with high surface hardness.

Baking schedules from one minute at 425 degrees F. to one hour at 150 degrees F. available.

Form-A-Roc formulation are also available in a wide range of colors and in a clear, tough, resistant topcoat.

•

The Varnish Products Co.

5206 Harvard Ave.
Cleveland, Ohio

FOUR IN ONE

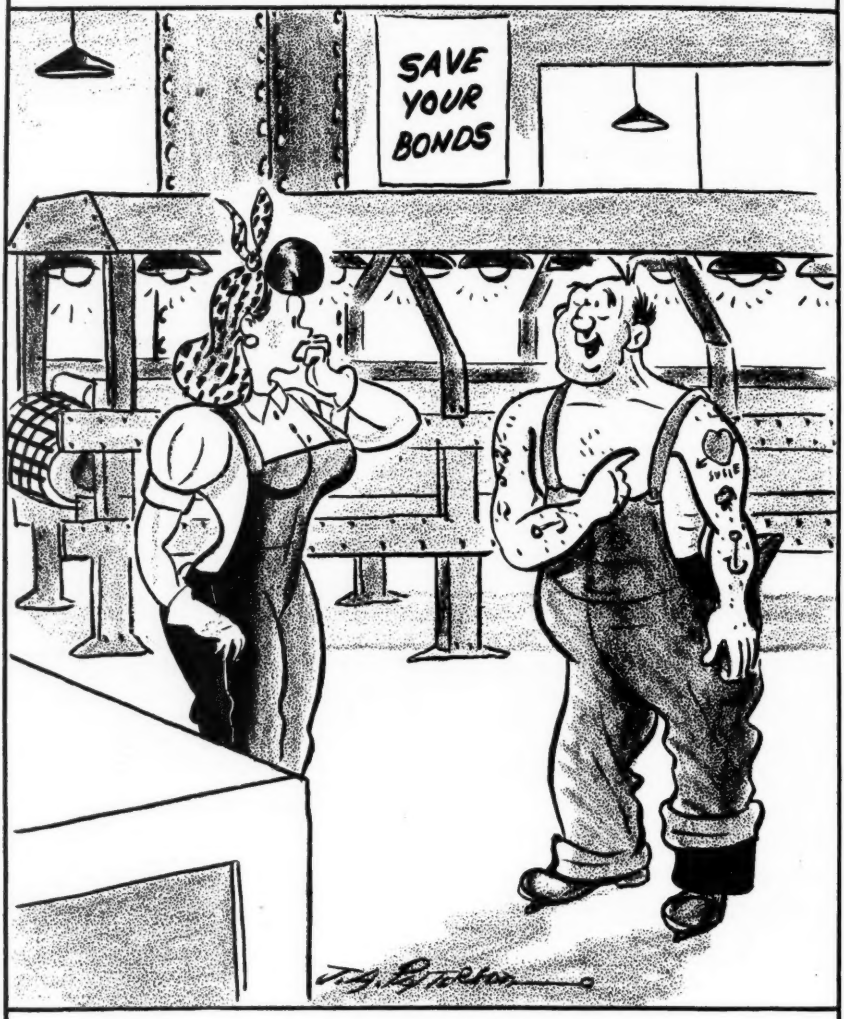
Grinding and Polishing Machine

This type R machine is a combination of several types of grinding and polishing machines. It can be used for disc grinding—polishing—burring and surfacing.

Write for illustrated folder

PRODUCTION MACHINE CO.
GREENFIELD, MASS.

The Finishing Touch — **By J. A. Patterson**



"You'd find it much cooler workin' like this!"